Exhibit 2

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OHIO
EASTERN DIVISION

IN RE: NATIONAL PRESCRIPTION OPIATE LITIGATION	)	MDL No. 2804
	)	Case No. 1:17-MD-2804
THIS DOCUMENT RELATES TO ALL CASES	)	Hon. Dan A. Polster

Saturday, May 4, 2019

HIGHLY CONFIDENTIAL - SUBJECT TO FURTHER CONFIDENTIALITY REVIEW

Videotaped Deposition of MEREDITH B. ROSENTHAL, Ph.D., held at Robins Kaplan LLP, 800 Boylston Street, Suite 2500, Boston, Massachusetts, commencing at 8:04 a.m., on the above date, before Michael E. Miller, Fellow of the Academy of Professional Reporters, Registered Diplomate Reporter, Certified Realtime Reporter and Notary Public.

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PROCEEDINGS
(May 4, 2019 at 8:04 a.m.)
THE VIDEOGRAPHER: We're now on record. My name is Vince Rosica. I'm a videographer for Golkow Litigation Services. Today's date is May 4th, 2019 and the time is 8:04 a.m.
This video deposition is being held in Boston, Massachusetts in the matter of National Prescription Opiate Litigation, MDL No. 2804, for the Northern District of Ohio, Eastern Division Court. The deponent is Meredith Rosenthal.
Counsel will be noted on the stenographic record. The court reporter is Mike Miller and will now swear in the witness.
MEREDITH B. ROSENTHAL, Ph.D., having been duly sworn, testified as follows:
EXAMINATION
BY MR. ROTH:
Q. Good morning, Professor Rosenthal.

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A. Good morning.
Q. My name is Martin Roth. We met off the record. I'll be taking your deposition here today.
Can you please state your full name for the record?
A. Meredith Beaven Rosenthal.
Q. And do you understand you're testifying under oath here today?
A. I do.
Q. And you've testified at depositions and in court and before Congress in the past?
A. I have.
Q. Approximately how many times altogether have you testified?
A. Perhaps 30 or 35.
Q. There's nothing that would prevent you from testifying truthfully here today?
A. There is not.
Q. If I ask you a question and you give me an answer, I'm going to assume you understood my question.
Is that fair?

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A. Yes.
Q. And if for some reason you don't understand one of my questions, you'll ask me for clarification?
A. Yes, I will.
Q. Okay. I'm going to start by marking as Exhibit 1 to your deposition your expert report, and I'm also going to simultaneously give you Exhibit 2, which is the errata sheet we received on Thursday night.
(Whereupon, Deposition Exhibit Rosenthal-1, 3/25/19 Expert Report, was marked for identification.)
(Whereupon, Deposition Exhibit Rosenthal-2, Errata to Expert Report, was marked for identification.)
BY MR. ROTH:
Q. So first, if you could look at Exhibit 1 and just confirm that that appears to be your expert report in this case along with Attachments A through D.
A. It is correct.
Q. And if you look at page 75, is that your signature on the report?

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A. Yes, it is.
Q. Exhibit 2 is a memo dated May 2nd from Forrest McCluer at GMA to yourself and Mr. Tom Sobol, your -- the attorney sitting with you; is that correct?
A. That's correct.
Q. And GMA is Greylock McKinnon?
A. That's correct.
Q. And who is Mr. McCluer?
A. Mr. McCluer is a senior economist there who worked with me on this matter.
Q. And I take it, given that Mr. McCluer went through the report to error check, that you believe that your report, along with the errata sheet, is accurate as of today?
A. I do.
Q. You didn't see any other errors that aren't contained in the errata?
A. I have not.
Q. And all of the opinions that you plan to give at trial in this matter are contained in your report as corrected by your errata?

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A. That's correct.
Q. Professor Rosenthal, you're a healthcare economist; is that correct?
A. Yes, that's right.
Q. You're not a medical doctor?
A. I am not.
Q. You're not an expert in the treatment of addiction?
A. I am not.
Q. You're not an expert in opioid use disorder?
A. I am not.
Q. And I looked at your CV. I don't think you've published on either addiction or opioid use disorder; is that correct?
A. I don't believe I have.
Q. You're not an expert in pharmacology?
A. I am not.
Q. You're not an expert in epidemiology?
A. I am not, although I do have some knowledge of epidemiology.
Q. You've reviewed epidemiological

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studies, but you're not an epidemiologist?
A. That's correct. An epidemiology class was required for my Ph.D., so I took an epidemiology class. I operate in the environment of public health research where epidemiology is an important strand that I frequently encounter, but I'm not an epidemiologist.
Q. And you're not a toxicologist?
A. I am not a toxicologist.
Q. You're not a pain management physician?
A. I am not.
Q. You don't diagnosis or treat pain?
A. No, I do not.
Q. You're not an expert in the FDA?
A. I am not an expert in the FDA, although, again, as you know, my work has frequently concerned FDA rules.
Q. But you've never worked for the FDA?
A. I have not.
Q. And you've never consulted a

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company regarding the meaning of FDA regulations or regulatory requirements?
A. I have not.
Q. You do understand that prescription opioids are FDA-approved products?
A. Yes, I do.
Q. And, in fact, if you look at your report, at paragraph 19, which is the bottom of page 15. Let me know when you're there.
A. Yes.
Q. You acknowledge that since 1962 the FDCA and related regulations have required sponsors of new drug products to present scientific evidence of both efficacy and safety before a new product can be marketed.
Do you see that?
A. Yes, I do.
Q. And you cite to the FDA website when you write that?
A. That's right.
Q. And then turning the page, you say in paragraph 20: By regulation,

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prescription drug labels indicate the diseases, conditions and/or patients for which the sponsor has presented scientifically required evidence to the FDA.
Right?
A. Yes, that's what it says.
Q. And for that proposition, you cite to a number of federal regulations in footnote 31?
A. I do.
Q. You're not an expert on drug labeling.
A. I am not.
Q. In paragraph 21 of your report, you say: FDA regulations specify that promotional materials may only make claims that are supported by scientific evidence, i.e., supported by studies meeting scientific standards, and they may not be false or misleading.
Did I read that correctly?
A. You did.
Q. And you're not an expert on FDA regulations, are you?
A. I am not.

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Q. And then in paragraph 22 you say: FDA oversight of drug promotion is intended to ensure that physicians and consumers understand both the benefits and risks of a drug. FDA regulations call for fair balance in all promotional claims and materials. The risks as well as the benefits must be clearly identified and risks must be given appropriate prominence.

Do you see that?

A. Yes, I do.

Q. And there's another citation to a Code of Federal Regulations section for that paragraph, correct?

A. Yes.

Q. You understand that the FDA regulates labeling for prescription drugs, based on what you've said in your report?

A. I do.

Q. And the FDA approves prescription drugs even if they have known risks?

A. Yes.

Q. Do you understand that the FDA also regulates promotional materials for

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prescription drugs?

MR. SOBOL: Objection.

A. Yes, I do.

BY MR. ROTH:

Q. And the FDA has authority to police advertising that it believes would result in prescription drugs being misbranded under the federal regulations?

MR. SOBOL: Objection.

A. I'm not sure exactly what you mean by "police," but as I've described in my report, I understand that materials are reviewed by the FDA.

BY MR. ROTH:

Q. And the FDA has the authority to tell a drug manufacturer to either modify or refrain from using materials that it may review?

A. I just want to be careful that I don't try to convey any legal expertise here, but I am aware that the FDA, for example, issues warning letters pertaining to specific marketing tactics and messages. If that's what you're referring to then, yes, I understand that.

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Q. Well, more than warning letters, the FDA may tell a manufacturer when it reviews draft promotional materials, for example, that it does not approve their dissemination.

Are you aware of that?

MR. SOBOL: Objection, asked and answered.

A. I guess I would have thought of that as similar -- again, not being a legal expert -- similar to those warning letters that say that you may not do this. The specifics of how the enforcement flows after that, what the FDA can and can't do in terms of enforcement, I'm a little less clear on.

BY MR. ROTH:

Q. Okay. And I appreciate that you're not a legal expert, but do you understand that in addition to issuing warning letters after materials may have gone out, the FDA, sometimes before materials are utilized, may give input and feedback to manufacturers about the materials that they plan to use?

A. Yes, I believe that's true.

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Q. And you did not study which, if any, of the promotional materials for prescription opioids were submitted to FDA for its review before they were used?

MR. SOBOL: Objection.

A. I did not study that, no.

BY MR. ROTH:

Q. And you did not study which of the detailing contacts in your regression models, which we'll talk about, involve promotional materials that had been submitted for FDA review?

MR. SOBOL: Objection.

A. I did not, no.

BY MR. ROTH:

Q. Do you agree that opioids have legitimate medical uses for certain diseases and conditions?

A. Yes, I would say that's true. According to their label, yes.

Q. And you understand that the FDA has approved opioids for certain of these conditions in their labels?

A. Yes, I understand that the approved labels include those conditions for

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which the FDA has deemed them appropriate.
Q. Did you review any drug labels in connection with your work in this case for prescription opioids?
A. I have looked at some of the drug labels, yes.
Q. Do you recall which drug labels you reviewed?
A. I believe for OxyContin and hydrocodone.
Q. Did you review any labels beyond that that you recall?
A. Not that I recall.
Q. And I've looked at Attachment B. I don't think I saw drug labels on your reliance list; is that correct?
A. That's correct.
Q. Do you understand that prescription opioids are approved in their labels for the treatment of chronic pain?
MR. SOBOL: Objection.
A. As I sit here, I couldn't tell you which drugs have approvals for chronic pain on their labels, no.

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BY MR. ROTH:
Q. Do you recall whether the OxyContin and hydrocodone labels you reviewed contained approvals for chronic pain for those drugs?
MR. SOBOL: Objection, scope.
A. I do not.
MR. SOBOL: Just give me a little bit of a chance to get my objections in, Professor. Just a nanosecond.
A. I do not recall.
BY MR. ROTH:
Q. Have you ever taken a prescription opioid before?
A. I have not.
Q. Have you reviewed any medical literature or guidelines on which uses prescription opioids are FDA approved for?
A. In the context of my report, I discuss some of the guidelines, so I -- and I've certainly reviewed those, for example, the CDC guidelines. I don't know if that's what you're referring to. I'm not specifically myself offering an opinion on

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those guidelines. As you know, as we just discussed, I'm not a clinical expert or a pharmacologist, but I'm certainly aware of guidelines that talk about the appropriate uses of opioids.
Q. Do you know the most common uses of opioids for which health insurers and federal Medicare or state Medicaid agencies reimburse use?
MR. SOBOL: Objection.
A. As I sit here, do I know which uses are most prevalent across all those payors? No. No, I do not.
BY MR. ROTH:
Q. Do you know whether Medicare, for example, reimburses patients for the use of prescription opioids for the treatment of chronic pain?
MR. SOBOL: Objection.
A. Well, I think you would be talking about Medicare Part D. Just to be clear, those are private insurers that are acting in the service of Medicare beneficiaries, and each, of course, has a different formulary and may use different

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mechanisms to ensure appropriate drug use.
So I think it would be hard to characterize that as Medicare as a whole.
BY MR. ROTH:
Q. Do you know whether any of the Medicare Part D insurers approve the use of opioids on their formularies for the treatment of chronic pain?
MR. SOBOL: Objection.
A. I do not know one way or the other. I do not believe that -- I do not know one way or the other whether there are restrictions relative to the uses of particular drugs for particular indications.
BY MR. ROTH:
Q. Okay. I'm going to mark as Exhibit 3 to your deposition a document that I pulled from your reliance list. It's titled Medicare Program Policies and Procedures, and it was linked to the Excellus Blue Cross Blue Shield page.
(Whereupon, Deposition Exhibit Rosenthal-3, Medicare Program Policies & Procedures, was marked for identification.)

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BY MR. ROTH:
Q. Do you see that document?
A. I do.
Q. And do you recognize this document as one that you reviewed?
A. I do.
Q. Okay. So why did you have your team pull this document and why did you review it in your work in this case?
A. I'd actually have to look in my report to see what I cite it for specifically.
Q. Okay. If you look on the first page, it says: Summary of Formulary Level Opioid POS for Calendar Year 2019.
Do you see that?
A. I do. And just to be clear, this is a single Medicare Part D carrier. This is not official Medicare policy per se.
Q. Right.
A. But yes.
Q. So if you look at page 3 of this document, it talks about the review criteria for Blue Cross Blue Shield for opioid, seven-day supply limits.

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Do you see that?
A. I do.
MR. SOBOL: Objection.
BY MR. ROTH:
Q. And then the first bullet -- or it says before the bullets: An exception to the seven-day quantity limit of a shorter long-acting opioid may be permitted in patients who meet one of the following criteria, A through F below.
Do you see that?
A. I do.
Q. And then the first bullet says: Approval will be a 30-day override for scenarios A, B, C, D and E below.
And then there's a second bullet below that. Do you see that?
A. Yes.
Q. And it says: Approval will be a 30-day override for scenario F below.
Do you see that?
A. I do.
Q. And then under that bullet is E where it says: The requesting physician provides a supporting statement/attests that

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a prescription for greater than a seven-day supply is medically necessary to manage the patient's pain.
Do you see that?
A. I do.
Q. And so at least for Blue Cross Blue Shield, it appears in their formulary they have a mechanism for approving the use of opioids to treat pain for longer than seven days?
MR. SOBOL: Objection. Blue Cross Blue Shield of? Question mark.
THE WITNESS: Are you waiting for me to answer your question?
MR. ROTH: I was.
A. This -- in this Excellus formulary, they do indicate -- obviously this is 2019. They do indicate that mechanism. You had asked me before about chronic pain. I don't know if you're trying to infer that anything longer than seven days is chronic. I think that's not exactly the definition of chronic pain, so...
BY MR. ROTH:
Q. We'll get there.

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A. Okay.
Q. I promise.
MR. SOBOL: I'll write that down.
BY MR. ROTH:
Q. Your direct and indirect regressions do not make any attempt to differentiate legitimate prescriptions from medically unnecessary ones; is that correct?
MR. SOBOL: Objection.
A. The goal of my analysis is to examine the impact of the alleged misconduct, and so I appropriately quantify all prescriptions caused by the alleged unlawful marketing.
BY MR. ROTH:
Q. You're not an expert in pharmaceutical marketing practices, correct?
A. I am not an expert in pharmaceutical marketing practices, although, again, I have studied pharmaceutical marketing and its effects and so I have a high degree of familiarity.
Q. But you're not opining on which of defendants' marketing practices were

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MR. SOBOL: Objection. Objection, asked and answered.
A. I did not evaluate the distributors' conduct, no.
BY MR. ROTH:
Q. So your models provide no analysis of causation by distributors or pharmacies for what plaintiffs allege is the opioid epidemic, correct?
MR. SOBOL: Objection, asked and answered.
A. The distributors' conduct was outside the scope of my report.
BY MR. ROTH:
Q. I want to take a look at the complaints you site in footnote 18 and 19. I assume you looked at those complaints?
A. I did.
Q. Okay. So I'm going to mark as Exhibit 4...
A. That is clearly not the whole complaint because I happen to know that it's several inches thick.
Q. Correct. You're right. I'm going to mark as Exhibit 4 just the cover

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page and the paragraph I want to ask you about, from the Second Amended Complaint filed by Summit County.
(Whereupon, Deposition Exhibit Rosenthal-4, Second Amended Complaint and Jury Demand, was marked for identification.)
BY MR. ROTH:
Q. Do you have that in front of you?
A. I do.
Q. And if you look at paragraph 10, which I excerpted from the complaint. Do you see it?
A. Yes.
Q. It says: On the demand side, the crisis was precipitated by the defendants who manufacture, sell and market prescription opioid painkillers, defined as the marketing defendants.
Do you see that?
A. I do.
Q. And then it says: Through a massive marketing campaign premised on false and incomplete information, the marketing

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defendants engineered a dramatic shift in how and when opioids are prescribed by the medical community and used by patients.
Do you see that?
A. I do.
Q. What do you understand to be the false and incomplete information that the alleged marketing campaign was premised on?
A. There are a number of components. At a high level, the main issue as I understand it as a health economist, not as a clinician, is -- was the -- that it was conveyed to physicians and to the public that opioids were safe; that the possibility of addiction was relatively low; that these drugs were effective, not just for cancer pain, but for a wide variety of acute and chronic pain.
And then there were other messages that were conveyed that supported those general premises, including the fact that extended release formulations of opioids would smooth out the peaks and valleys of pain control; that as patients became tolerant to these drugs, that this was a

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natural phenomenon and not a sign of addiction.
There were certain notions such as pseudoaddiction that were promoted through communication by the marketing defendants. And at the same time, it was also conveyed that physicians could identify some small group of patients who might be more likely to abuse opioids and prevent and control abuse, that this was an issue related to the individual characteristics and not to the products themselves.
Q. Okay. What analysis did you do to test whether the detailing visits you analyzed communicated that false and incomplete information as you just described it during those visits?
A. Well, I think you misunderstand the entire premise here. As I noted earlier, detailing, while it is the promotional tactic that I can best measure and use in my analysis, the allegations suggest that this campaign of misinformation permeated through many other vehicles.
And so it's not in my view,

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again, as a health economist, a question of ascertaining what was in a particular detail, but what was available in -- through key opinion leaders, what was available through professional guidelines, all of that setting the context. So it's not so much about looking for one co-mission as a much broader picture of what the information was that was conveyed.

Q. Okay. You've testified as a causation or damages expert before, correct?

MR. SOBOL: Objection.

A. I have.

BY MR. ROTH:

Q. And in general, you understand that to opine on causation or damages, you have to tie the theory of liability to damages?

MR. SOBOL: Objection.

A. Yes, and I have done that in my report.

BY MR. ROTH:

Q. Okay. The complaint defines a theory of liability here as false and incomplete information, correct?

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A. Yes, correct.

Q. What have you done to confirm that the detailing visits you analyzed actually contained false and incomplete information as the complaint or you define it?

MR. SOBOL: Objection, just asked and answered.

A. As we talked about earlier, I've been asked to assume that counsel will prove that all or virtually all marketing during the period from 1995 to the end of my data was unlawful.

So I have tested the reasonableness of that assumption in the review of the documents that we've talked about, in the review of other expert opinions.

I have not, nor do I believe it's necessary to make that causal step, looked at individual details throughout the period for my analysis.

BY MR. ROTH:

Q. You would agree that detailing in and of itself is not unlawful?

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MR. SOBOL: Objection.

A. Well, again, if that detailing is conveying false and misleading information, I understand -- I'm not a lawyer, but I understand that it would be unlawful. And so, you know, I do not -- I am not making an assumption that detailing in general is unlawful but that this detailing can be proved to be unlawful.

BY MR. ROTH:

Q. A pharmaceutical rep going to a doctor to drop off a pizza could be considered a detailing visit, correct?

MR. SOBOL: Objection.

A. A detailing visit generally involves the conveyance of some information, maybe a pizza in addition, but the details that I'm looking at, there is a specific product mentioned.

BY MR. ROTH:

Q. But detailing visits can take many forms, correct?

MR. SOBOL: Objection.

A. Well, I'm not sure exactly what you mean by it. There's information conveyed

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about a product or a set of products, and detailing visits are face-to-face visits between the salesperson and someone in the physician's office.

BY MR. ROTH:

Q. But you know that detailing could just be the sales rep dropping off a placard with the product's label on it?

MR. SOBOL: Objection.

A. I think you misunderstand, again, the interconnectedness of all of this. And so if a detail were something like you just described -- I don't know about a placard, how about a coffee mug -- those details are intended to reinforce messages that have been conveyed in previous details that have been conveyed by key opinion leaders.

I don't think it's appropriate to pull these individual pieces out as if they were not part of an integrated marketing scheme, which is really precisely what Dr. Perri talks about in his report.

BY MR. ROTH:

Q. But you're not offering the

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opinion that every time a sales rep detailed a doctor for an opioid product, that was unlawful?

MR. SOBOL: Objection.

A. I am not offering any opinion about the unlawfulness of detailing, as we have spoken about before. I was asked to assume that plaintiffs' counsel would prove that marketing was unlawful.

BY MR. ROTH:

Q. We'll come back to this, but I'll give you a break from it.

If you look back at paragraph 7, you say in paragraph 7 of your report -- sorry: In this report I refer to the manufacturers' deceptive marketing strategy and tactics as manufacturer misconduct. This report does not address nonmarketing misconduct.

Do you see that?

A. Yes.

Q. What is your definition of nonmarketing misconduct?

A. By that, I mean to describe misconduct related to identifying and

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intervening with suspicious shipments, the distributor misconduct, as I understand it, yes.

Q. Okay. And then in paragraph 8 you say: My assignment is to answer the following questions framed by plaintiffs' counsel.

Do you see that?

A. I do.

Q. And each of the bullets is bounded -- I guess with the exception of the sensitivity -- each of the first three bullets is bounded by the year 1995.

Do you see that?

A. Yes.

Q. So since 1995 I'm going to look at causation.

Can you explain why 1995 was selected?

MR. SOBOL: Objection.

No discussions with counsel, but if you have a general understanding, that's fine.

A. My general understanding is that counsel for plaintiffs intend to prove

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that marketing since 1995 was unlawful.

BY MR. ROTH:

Q. Do you have any independent understanding as to why that would be a good measuring date?

A. As I sit here specifically, no. It will get into the specific facts that I describe in my report in terms of what is happening in opioid prescribing in the world in 1995, and that is certainly a turning point in the -- in opioid use, as you can see from the sales data I have.

Q. Is there a specific event that happened in 1995 that you believe was the start of the unlawful marketing scheme alleged in the complaint?

A. As I sit here, I can't think of anything specifically, no.

Q. Okay. I'm sure we'll talk about this later, but I know from sitting through Professor McGuire's deposition and Professor Cutler's deposition, that as Professor McGuire described it, there was a triumvirate of damages experts in this case?

A. Quadrumvirate.

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Q. If you include Professor Gruber?

A. Yes.

MR. SOBOL: You can't forget John.

BY MR. ROTH:

Q. So you understand, I take it, that Professor Cutler calculates harms beginning in 2006?

A. Yes.

Q. And did you review his report before finalizing your report?

A. Before finalizing my report, I believe I did.

Q. And you had conversations with him about your models and I assume about his models as well?

A. With counsel present, we talked about the work as a whole.

Q. Okay. Do you know why calculating a harm from 2006 forward as he does requires looking at misconduct dating back to 1995?

MR. SOBOL: You can answer only if it's not based on counsel.

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A. Based on my understanding of the economic phenomena of interest, yes. So, as I'm sure we will discuss and you know, my model examines the effects of marketing over time, and marketing has long-lasting effects. So what happened in 1995 is still affecting the world in 2006.

Moreover, of course, harms such as overdose deaths are lagged somewhat to the start of someone's experience taking an opioid. So it's important to take a look at the entire time period.

BY MR. ROTH:

Q. And we will talk about the stock of promotion and how you calculate that.

But the way you calculate that, if you started back in 1990 or 1985, it would still have an impact on 2006; isn't that right?

MR. SOBOL: Objection.

A. What's important is when the but-for marketing departs from actual marketing, so that is why those earlier periods matter and going back to 1985

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wouldn't matter because but-for and actual marketing are the same.

BY MR. ROTH:

Q. And the reason you say but-for and actual marketing are the same is the assumption that the scheme started in 1995?

MR. SOBOL: Objection.

A. Yes, the assumption that I used to calculate but-for marketing is that the defendants' marketing after 1995 was unlawful.

BY MR. ROTH:

Q. You have not done any analysis of causation as to non-defendant manufacturers; is that correct?

MR. SOBOL: Objection.

A. Well, my model includes all opioids in this category. We can talk about I exclude the injectables. There's some exclusions.

But I examined the effect of marketing on sales beyond the defendants, so I provide causal estimates of the effective marketing on sales for non-defendants. And then separately, again, I'm sure we will get

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to this, I break out non-defendant marketing on behalf of defendants in my Table 3.

So I am looking at causation for non-defendants. I'm simply not attributing it to misconduct and therefore passing it on to Professor Cutler.

BY MR. ROTH:

Q. And with respect to the non-defendants, you're doing it on an aggregate basis as opposed to specific companies; is that correct?

A. My main analysis is on an aggregate basis, and then I do some sensitivity analysis where I remove individual defendants and then all the non-defendants' marketing on behalf of defendants.

Q. Do you know whether any of the non-defendant manufacturers utilize similar messaging in their promotional visits to the ones that the defendant manufacturers did that you described as the fraudulent scheme earlier?

A. I have not examined that question, no.

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Q. And if a court or jury were to find that those types of messages were unlawful for defendants, how would that affect how you calculate causation with respect to the non-defendants?

MR. SOBOL: Objection.

A. That seems to me to be a legal question. This matter has a specific set of defendants, and I am calculating impact for those defendants. I'm not sure if you're suggesting if I could include other manufacturers in those calculations? Absolutely. But that seems like it would be outside the scope of this matter.

BY MR. ROTH:

Q. And I think we talked about the illegal drug trade, but specifically, have you done any analysis as to causation with respect to pill mills?

MR. SOBOL: Objection.

A. No, I have not.

BY MR. ROTH:

Q. Or cartels or Internet sales of opioids?

A. No, I have not.

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Q. You've done no analysis as to causation due to changes in reimbursement policies for prescription opioids?
MR. SOBOL: Objection.
A. I have not looked at changes in reimbursements specifically, no.
BY MR. ROTH:
Q. You've done no analysis as to causation as to changes in medical guidelines for the use of opioids?
A. Well, I do, as you know, in one model look at the effects of certain guideline-related events, so that happens in my Model C. But aside from that, I have not modeled other changes in guidelines, but to some extent there, yes.
Q. You've done no analysis of causation as to patients or users of prescription opioids?
MR. SOBOL: Objection.
A. I'm not really sure what you mean by that. My analysis is an industry-level analysis, so the patients of course are the ones filling the prescriptions that I'm counting and measuring.

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So in the indirect analysis, I look at population characteristics as they are associated with shipments, cross-sectionally, so that is in some sense a patient-level analysis. I'm not entirely sure what you had in mind, however.
BY MR. ROTH:
Q. You don't attribute any causality to prescribing doctors?
MR. SOBOL: Objection.
A. Again, I am -- marketing is to doctors, and the doctors have to write the prescriptions, so they are in the causal chain of my analysis.
The mechanism is a detailing contact. If doctors did not respond to those details, then they -- my results would be quite different.
BY MR. ROTH:
Q. I understand they're in the causal chain. What I'm trying to understand is how your models assign a percentage of causality to prescribing doctors.
MR. SOBOL: Objection.
A. Again, from my point of view,

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the question doesn't make a lot of sense to me because of the fact there is this causal chain, and what I've been asked to undertake is an analysis of the impact of the allegedly unlawful marketing.
It goes through doctors, so there -- the idea that there's a separate analysis of the effect of doctors on prescribing, they're already in my analysis. The question about parsing liability for those groups, I have not undertaken that because I'm not a lawyer, and I was not asked to offer an opinion on that.
BY MR. ROTH:
Q. And when you say the doctors are already in the analysis, they're in the analysis to the extent you're talking about detailing, but other factors that may influence the doctors' prescribing decision are not accounted for in your analysis, correct?
MR. SOBOL: Objection.
A. Well, again, I would say that's not entirely correct because these other factors that I capture in my model using

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those eras, in addition in Model C, using the specific dummy variables, those operate through physicians.
And again, because these are prescribed products, the doctor has to write the prescription in every case, so even, you know, efforts, for example, to change the way state medical boards enforce prescribing around opioids, that's -- that's ultimately directed at doctors.
BY MR. ROTH:
Q. You agree that doctors act as a trusted intermediary when it comes to prescribing opioids?
MR. SOBOL: Objection.
A. As a matter of the way this market works, yes, that doctors are intended to be the agents of their patients.
BY MR. ROTH:
Q. You say in your report, paragraph 14: Physicians act as a trusted intermediary in prescription drug decision-making.
MR. SOBOL: Objection.
A. Yes.

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question, which is: An individual doctor's prescribing habits can be confounded by other unobserved characteristics?

MR. SOBOL: Objection.

A. I don't know what you mean by confounded. When you say confounded, I am assuming -- and please correct me if I'm wrong -- that you're asking that in a sort of statistical sense.

BY MR. ROTH:

Q. Yeah. Okay. So, I am.

(Whereupon, Deposition Exhibit Rosenthal-5, 2016 Datta and Dave Publication, was marked for identification.)

BY MR. ROTH:

Q. Let me mark as Exhibit 5 is Datta and Dave study --

A. I keep thinking it's "Dah-vay."

Q. You know, I did too. Well, however you pronounce the gentleman's name, I apologize, Effects of Physician-directed Pharmaceutical Promotion on Prescription Behaviors: Longitudinal Evidence.

Do you have that in front of

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you?

A. I do.

Q. And this is a study you rely on and cite in your report?

A. That's correct.

Q. And this study actually looked at longitudinal evidence and developed a regression to determine the effect of marketing and other behaviors?

A. Yes. But just to be clear, when they say longitudinal, they're not wrong, but they're talking about two years of data. This is -- this is a bit different than the aggregate time series that I used. So just to be clear, they have multiple observations per physician over a two-year period.

Q. Okay. If you turn to page 456, and at the bottom of the page -- or sorry, let me get myself to the right place. Sorry, it's -- yeah, it's 456, bottom of the page.

A. Okay.

Q. The very last sentence, it says: Furthermore, the link between DTPP and prescribing habits may be confounded by other

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unobserved physician-specific characteristics such as inertia in prescribing patterns, brand loyalty, patient mix, tolerance for risks and preferences toward trade-offs between efficacy, contraindications and long-term use for prophylactic purposes.

Do you see that?

A. Yes. And again, those are all cross-sectional concerns, so when one is doing an analysis, as they do, that incorporates both cross-sectional and time series variation, so they have a panel of physicians that they're looking at their prescribing for a particular herpes drug and its competitors.

And when you're looking cross-sectionally like that at physician-level data, you would need to account for those physician characteristics when you're looking at aggregate data over time that you would not need to look for those characteristics.

Q. And you look at aggregate data?

A. That's correct.

Q. Did you try to look at

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physician-specific cross-sectional data?

MR. SOBOL: Objection.

A. Unlike Datta and Dave, I do not have promotional data at the individual physician level. As you no doubt noted in their literature review, it's fairly uncommon to be able to get data that have physician-level detailing, which is what they use, as well as prescribing habits. So there are a few marketing scholars who essentially have had good relationships with companies and have been able to get those kinds of data. I don't have access to those data.

BY MR. ROTH:

Q. Well, you understand that all these companies are defendants in the case and have produced documents as part of the lawsuit, correct?

MR. SOBOL: Objection.

A. I understand that these companies have produced documents as part of the lawsuit. They have not produced data with detailing information by physician that can be identified and linked to prescribing.

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BY MR. ROTH:
Q. And --
A. I did look for those data.
Q. You did look for it. And that's true of every single manufacturer defendant, there is no physician-level detailing data available?
MR. SOBOL: Objection.
A. There were no physician-level detailing data for any manufacturer that covered the period of interest. So in order for me to do my analysis, I would need those data for all the defendants for the entire time period.
So where -- to the extent that we found any data, they were bits and pieces of contact registries, essentially sales databases, which are not the same level as what these folks have -- they have actual linked data, linkable.
BY MR. ROTH:
Q. But you didn't take the specific data you had for individual defendants for whatever time period you had to test the results of your regression

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against a model you could do on just that data?
MR. SOBOL: Objection, form and asked and answered.
A. There would be no such test. These -- the goal of my analysis and the goal of Datta and Dave's analysis are completely different. So there -- there would be no point in comparing those results.
They are trying to ascertain the extent to which detailing across physicians drives marketing impact, so they're really interested in questions like, you know, what -- how -- how much does it make sense for a company to detail high prescribers versus low prescribers to a greater degree.
I'm interested in the aggregate impact, and so that is what my model does best. Their model would not be appropriate for ascertaining the aggregate impact.
BY MR. ROTH:
Q. I understand you're interested in the aggregate impact, but if one were interested in the individual impact of any

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single manufacturer's detailing, you could run an analysis similar to Datta and Dave using whatever data were available for that manufacturer?
MR. SOBOL: Objection.
A. There are two levels of aggregation here. One is from the doctors up to the total product level, and the other is from the product to the defendant to the whole class, if I can use that term to describe all the opioids that we're interested in here.
So Datta and Dave are at the most granular level, the individual doctor prescribing for an individual drug.
I am interested in understanding how marketing as a whole drove sales in this market and I want to capture all of the spillover effects. They're trying to tease out other kinds of effects.
This analysis could not be used to get an answer to the question what would have happened if these manufacturers had not marketed their products.
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BY MR. ROTH:
Q. And the reason you're interested in the aggregate question is that was the charge you were given by plaintiffs' counsel was to look at the aggregate impact as opposed to an individual defendant-specific impact?
A. Well, again, there are multiple levels of aggregation here, so if I -- my model, as you know, can be used to parse out individual defendants as I have done in Table 3 of my report, so it can look at an individual defendant, and I've shown you results excluding individual defendants. So it is already doing that.
It's the cross-sectional nature of what they're modeling here with the physician-fixed effects. They're really trying to tease apart how manufacturers go about targeting doctors for marketing and what effect that has.
I'm not interested in that effect, and so it wouldn't be appropriate even if I were only looking for one defendant.

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Q. So you're not interested in trying to ascertain how manufacturers' targeting for marketing has an effect.
What is the question you're seeking to answer?
MR. SOBOL: Objection.
A. The question that I'm seeking to answer is what is the effect of marketing by defendants for opioid products on their sales, and if that effect --
BY MR. ROTH:
Q. I'm sorry to stop you. At an aggregate level, I assume you mean?
A. At an aggregate level. Again, my model can look -- pull out the effect for individual defendants, but at an aggregate level.
And so all I'm saying is that if that effect comes because one manufacturer targets just the high prescribers and is very effective there and another manufacturer details everybody, that is not relevant to what I have been asked to undertake in this case, and so I don't go into the level of -- the physician level the way Datta and Dave do

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because it's -- it's not relevant to my conclusions.
Q. Have you tried, for any of the individual manufacturers for which you have specific data, to pressure test your conclusions in Table 3, from removing them from the aggregate data to see if those hold?
MR. SOBOL: Objection, form.
A. Can you repeat? Because I just want to make sure I understand the question you're asking.
BY MR. ROTH:
Q. Yeah. So as I understand your model -- and again, we will get into the details, I promise -- but you essentially back out from the aggregate model individual defendants, and you present those in Table 3.
MR. SOBOL: Objection.
A. That's correct.
BY MR. ROTH:
Q. So my question is: Have you run a Datta and Dave type of analysis for any of the individual manufacturers listed in Table 3 to compare how the aggregate results in Table 3 hold compared against the Datta

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and Dave type analysis we've been discussing?
MR. SOBOL: Objection, asked and answered.
A. I think, again, you misunderstand what the utility of the Datta and Dave analysis is. It is an analysis that is designed to dig into how marketing works and not whether.
There would be no utility in comparing results of a Datta and Dave analysis, if one were possible, with my aggregate results because the questions they're looking at are entirely different.
BY MR. ROTH:
Q. And why is the question you answer only about how marketing works as opposed to whether?
A. No. Sorry. Their how.
Q. Okay. Why is -- So how are you answering the question through your aggregate model whether marketing works if you're not looking at it on an individualized doctor-specific level?
MR. SOBOL: Objection.
A. My analysis is a model of the

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effect of detailing as a whole for this class, its effect on sales in the form of milligrams of morphine equivalent, just to be clear.
So my right-hand side variable is detailing. My left-hand side variable is MMEs. Datta and Dave -- so that tells me, if marketing increases in this area as a whole, what happens to MMEs? That's the question that relates to my assignment.
Datta and Dave are asking, you know, can we examine and tease out to what extent manufacturers target specific types of physicians and whether the prescribing of physicians is more driven by this targeting question or by the marketing effectiveness.
They're doing so on a very short time period in the scheme of things, right? So two years of data doesn't -- doesn't allow them to look, for example, at what happened before that two-year time period in terms of the buildup of knowledge about these products, all of those things that are captured in the stock of detailing that I use.

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And so they have this interesting work that tells us something about responsiveness of physicians, but it doesn't get us to the aggregate question about how -- to what extent does marketing across all of their drugs affect the size of the market.
BY MR. ROTH:
Q. What have you done to answer the individualized question of whether targeting certain physicians by the manufacturers in this case was the cause of additional MMEs as opposed to the effectiveness of the marketing overall?
MR. SOBOL: Objection.
A. That question is not relevant to my charge. I want to understand what is the total effect. I have -- I do not know why the court would want to understand what aspects of the targeting of specific physicians that drive marketing increases.
BY MR. ROTH:
Q. What have you done to answer the individualized question of whether certain messaging by individual manufacturers

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led to an increase in MMEs?
MR. SOBOL: Objection.
A. As we have discussed, I am taking an assumption from counsel, as experts always do, that they will prove their case, and specifically, the relevant assumption I have made is that all or virtually all marketing by defendants from 1995 to the end of my data was unlawful.
I have reviewed documents and other expert reports. I have not parsed out individual messages and in any way parsed out the marketing that I assume to be unlawful in my model to differentiate from one to another.
BY MR. ROTH:
Q. Do you agree that standards of care influence prescribing decisions?
A. What -- do you mean by standards of care something very general or do you mean that in the sort of the negligence sense, since you're a lawyer?
Q. That's fair. You've done this a lot because you went somewhere that I wasn't going.

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I meant the more general. Do you agree that sort of the prescribing and treatment standards of care can influence prescribing decisions?
A. Again, I would say if we looked at my ecosystem, I don't know that I call out standards of care specifically, but if those, for example, are set in part by what your peers are doing, if those are set in part by professional guidelines, then, yes, I believe that those are relevant determinants of physician behavior.
And as I said earlier, I also believe that those would be affected by the alleged misconduct.
Q. Although detailing is not the same as affecting the standards of care, right? Those are two different marketing channels?
A. It's not clear to me that detailing would not affect the standards of care. Detailing could, for example, try to convince individual physicians that it's okay to prescribe opioids more broadly by citing guidelines, by citing peers and key opinion

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leaders. So I think it could well be wrapped up. I don't know why they'd be independent.
Q. Do you agree that patient preference can affect a physician's prescribing decision?
A. Yes, of course patient preference can affect a physician's prescribing decision.
Q. Loyalty to certain drugs can affect a physician's prescribing decision?
A. Physicians -- it has been found in the literature that physicians have a tendency to prescribe a particular drug once they've gotten used to it, so in the antidepressant class, for example, that's been shown.
Q. Drug reimbursement policy can affect physician's prescribing decisions?
MR. SOBOL: Objection.
A. Yes, all of these factors, the last two factors, I would say they're most likely to affect physician prescribing patterns by the specific brand or brand -- in the case of reimbursement, brand versus generic as opposed to whether the physician

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prescribes an opioid.
BY MR. ROTH:
Q. And we'll get to this later, but to the extent you're looking at detailing visits, you don't differentiate between detailing visits that are just driving at rivalrous marketing to get a prescriber to switch opioids versus detailing visits that are trying to get doctors to prescribe opioids as a class of therapy?
A. I don't differentiate on the right-hand side, and so if, in fact, detailing was all rivalrous, my results would show that marketing doesn't affect sales. So that is the point of the analysis, is to ascertain.
So you could imagine doing an analysis in a market that has a fixed size, where all marketing is rivalrous, and there's some discussion for other drugs where marketing appears to be more about market share and not about driving the size of the market as a whole.
But, in fact, my analysis shows that the market expansion effects were

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important, whether or not there was also rivalry.
Q. You agree, though, that if a manufacturer was only engaged in rivalrous marketing, for example, that would be qualitatively different than trying to make the market and convince prescribers to move patients on to opioids?
A. I don't believe in the conceptual premise that you have just put forth that there's such a thing as purely rivalrous marketing, in the case where the market is not fixed by some reason.
So even if, you know, I go and I market for Coke and it's not that I'm trying to get you to drink more sugar-sweetened beverages, I just want you to stop drinking Pepsi, that will still remind some people that, oh, yeah, I should think about having a Coke this afternoon instead of my usual coffee.
So I think there will be market-increasing spillovers even from purely rivalrous marketing.
Q. The economic literature doesn't

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agree with you on that, though?
A. I'm not sure that that's true.
Q. We'll look at it.
A doctor's own medical judgment can affect prescribing decisions?
A. I think it would be very difficult to say that that was not true.
Q. And in fact, I think Professor Cutler has got a working paper where he draws that conclusion. Have you studied that or read that paper?
A. You'd have to put it in front of me.
Q. We can look at it quickly.
(Whereupon, Deposition Exhibit Rosenthal-6, 2015 Cutler et al Working Paper, was marked for identification.)
BY MR. ROTH:
Q. So I'll mark as Exhibit 6 Physician Beliefs and Patient Preferences: A New Look at Regional Variation in Health Care Spending.
And if you look at page 5, do you see in the middle of the page there's a paragraph that starts with "Ultimately"?

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A. Uh-huh.
Q. He says --
MR. SOBOL: Wait, is this an excerpt or is this the whole article?
THE WITNESS: It's an excerpt.
MR. ROTH: It's an excerpt. It's an excerpt.
A. I just want to just review the front piece so I can --
BY MR. ROTH:
Q. Sure.
A. -- understand what it's about.
(Document review.)
A. Okay.
BY MR. ROTH:
Q. So in the paragraph I was pointing you to, it says: Ultimately, the largest degree of residual variation appears to be explained by differences in physician beliefs about the efficacy of particular therapies. Physicians in our data have starkly different views about how to treat the same patients. These views are not strongly correlated with demographics, financial incentives, background or practice

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characteristics and are often inconsistent with evidence-based professional guidelines for appropriate care.
Do you see that?
A. Yes, I do.
Q. And do you have any reason to believe that is not true of physicians when they prescribe opioids?
MR. SOBOL: Objection.
A. Well, just to be clear, the context that they're looking at is not one that's subject to marketing, but in any case, there's no presumption here that those beliefs are not set by some other factors, right.
So they're -- they're -- they're trying to identify all the forces that they can measure, including financial incentives and other characteristics, and so they're putting in beliefs everything else.
But that's not to say that those beliefs couldn't be shaped by marketing. So I think it would be a mistake to consider beliefs as independent. I wouldn't say that they're a hundred percent

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set by marketing, but they're clearly influenced by marketing. That's really the issue at hand here.
BY MR. ROTH:
Q. Are there physicians in the world who don't allow detailing in their offices?
MR. SOBOL: Objection.
A. Yes. But again, I think conceptually, that's the wrong way to look at this, as I have noted in my report, that even if you never have someone detail you, you're -- you're connected with peers, you are getting messages through professional societies.
It would be hard to imagine a physician who's completely untouched by the alleged misconduct in this matter.
BY MR. ROTH:
Q. Do you agree that characteristics of individual patients can obviously affect prescribing decisions?
A. Yes. I would hope that physician characteristics matter to -- sorry, patient characteristics matter to physicians

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when they're prescribing.
Q. And then you also mentioned this earlier, but risk aversion or potential medical malpractice liability could also influence prescribing decisions?
A. That is possible. That is possible, and I believe that is part of what the model guidelines for state medical boards is intended to address.
Q. Okay. And just so I understand your position on this, do you believe there are aspects of a doctor's prescribing decision that are unaffected by marketing, or is it your view that marketing infiltrates everything in their mind at the time they decide to prescribe a product like a prescription opioid?
MR. SOBOL: Objection.
A. I don't know exactly what you mean by that, but I can tell you what I believe. I believe that modern pharmaceutical marketing, including the tactics that are described in the complaint in this matter, is comprehensive and ubiquitous.

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Does that mean it is strictly determinative of what every physician does for every patient? No, I do not believe that. I do believe that marketing, it can't be teased out in terms of looking just at what physicians were detailed, but it has an influence that is quite broad.
Other factors will certainly be important, but the question here is really what is the incremental effect of marketing on the prescriptions that physicians write.
BY MR. ROTH:
Q. Have you reviewed the facts of any prescription by a doctor of an opioid in this case?
A. I don't think so, no.
Q. And you don't know how, on an individual level, a specific doctor was affected by a detailing visit in your model because you haven't done that analysis?
A. I have not looked at individual physician-level data as we discussed, and I do not believe it is the most appropriate path to fulfilling my assignment.
Q. Okay. And your model does not

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attribute any percentage of causality to prescribing doctors for the increased volume of MMEs that you calculate?

MR. SOBOL: Objection, asked and answered.

A. As we've discussed earlier, that notion, just conceptually, I struggle with the idea that you're asking me to consider. Every prescription in my data was written by a physician.

BY MR. ROTH:

Q. Right. But I asked a little bit of a different question.

You don't have a percentage line in your report for doctors the way you do in Table 3?

MR. SOBOL: Objection, asked and answered.

A. Well, again, just that would make no sense to me, so the marketing in question operates through doctors.

MR. ROTH: Why don't we take a five-minute break.

MR. SOBOL: Okay.

THE VIDEOGRAPHER: The time is

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9:31 a.m. We're now off the record.

(Recess taken, 9:31 a.m. to 9:46 a.m.)

THE VIDEOGRAPHER: The time is 9:46 a.m. We're back on the record.

BY MR. ROTH:

Q. Professor Rosenthal, if you could turn to page 13 of your report, paragraph 16, and tell me when you're there.

A. Yes.

Q. You've got a heading, The Role of Public and Private Health Insurance.

Do you see that?

A. Yes.

Q. And you say in paragraph 16: Another distinguishing feature of pharmaceutical demand is the widespread presence of insurance coverage. As of 2017, approximately 88% of nonelderly adults have insurance coverage through a private or public health insurance plan.

Do you see that?

A. I do.

Q. And then you go on to talk about the Affordable Care Act and then you

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say: Insurance coverage among the elderly is virtually universal, and among those enrolled in Medicare, the vast majority have prescription drug coverage either through Medicare Part D or retiree plan.

Do you see that?

A. Yes.

Q. We talked about this a little bit earlier, but are you aware of pharmacy benefit managers?

A. Yes, I am.

Q. What are they?

A. Pharmacy benefit managers are essentially specialty health insurers. They manage only the pharmaceutical part of the health benefit, and they typically contract either with a primary health insurer or a self-insured employer.

Q. And what role do they play in providing insurance coverage or approving prescriptions of opioids?

A. Pharmacy benefit managers, they have pharmacy networks, so they negotiate contracts with pharmacies. They adjudicate claims electronically. They typically define

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formularies, so which drugs are covered, and they offer employers and health plans alternative copayment structures. So those are their main roles.

Q. And you just mentioned formularies. How would you define what a formulary is?

A. A formulary is a list of covered drugs. An open formulary means that the list is preferred drugs, but other drugs are still eligible for reimbursement. A closed formulary is a list of drugs that are exclusively covered by a health plan.

Q. Given the pervasiveness of insurance and the role that PBMs and formularies play, what analysis did you perform on the role of insurers in assessing the volume of MMEs in your models?

A. Well, if I understand you correctly, I think we have a very similar situation conceptually to the one we talked about earlier with physicians, not a hundred percent the same.

But PBMs and health insurers adjudicate and pay for claims associated with

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opposed to the uncovered therapy, recognizing as you did that there may be other reasons why she might have a preference?
A. Such as addiction risk and the like. I think the out-of-pocket cost will be relevant to that decision.
Q. I promise we're almost to your models. Just one more general area first.
Your direct model is based on national data with respect to detailing, correct?
A. Yes, it is.
Q. And nationwide data with respect to MMEs dispensed as well?
A. Yes, it is.
Q. Your indirect model is based on the ARCOS data, which you describe as county level, and we can talk about that later; is that right?
A. Yes.
Q. Okay. That was a terrible question.
So your indirect model is based on the ARCOS data, which is then subdivided into county-level data.

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A. It is. I guess when you say subdivided, I think it comes that way, but yes, right.
Q. And your indirect model does not have a detailing variable because you're essentially solving for marketing by including other variables in that approach?
A. Yes. The purpose of the indirect model is to go another way around and ignore the detailing data.
Q. If you take out -- put another way, if you take out everything else that would be relevant, what is left is detailing in the indirect model?
A. Yes.
Q. Okay. So the only model with detailing data is the direct model, and for that you use national data?
A. That's correct.
Q. So you don't have any model that measures the effect of detailing within either Summit or Cuyahoga County?
MR. SOBOL: Objection.
A. My model looks at detailing as a national phenomenon, which as I note in my

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report, detailing is generally a national phenomenon.
And I take the relationship between detailing and sales, and I apply it to Summit and Cuyahoga, or it ultimately gets applied downstream rather, but I do not have detailing at a level other than national and so cannot run a model at a lower level of geography.
It's my belief that these patterns are the same across the country, and I believe there's some testimony to that effect.
BY MR. ROTH:
Q. So you did not model marketing within either Summit or Cuyahoga County against MMEs within Summit or Cuyahoga County?
A. As we've discussed, my model looks at these relationships at a national level because that is really the level at which manufacturers set their strategy and the appropriate level to look at the effectiveness of marketing.
Q. Do you know how many of the

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detailing visits in your data occurred in Summit County or Cuyahoga County?
A. In the IMS -- or, rather, excuse me, the IQVIA data specifically, there is not a method for apportioning those from county to county.
Q. Did you do any analysis as to whether the impact of defendants' marketing varied by county, or was it not done because you assumed it was national in scope?
MR. SOBOL: Objection.
A. I believe that is appropriate to assume that the effectiveness, the relationship between marketing and sales is the same across counties, and -- and again, my data do not allow me to parse out detailing at a county level.
So where -- where it is possible to parse out sales at a county level, it is not possible to do so for detailing. So I did not test that.
BY MR. ROTH:
Q. Okay. Professor Cutler takes your percentage, though, and applies it to his regression, which is done at a county

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level; is that right?
MR. SOBOL: Objection.
A. Professor Cutler's calculations, once he has looked at the effect of shipments on harms, he then applies my percentage to that, yes.
BY MR. ROTH:
Q. Did you have any conversations with Professor Cutler about the fact that he was taking your national model and then applying it to his county model and what that might mean for his results?
MR. SOBOL: That's a yes or a no.
A. Yes.
BY MR. ROTH:
Q. Did you have any of those conversations outside of the presence of counsel?
A. No.
Q. Do you have any view about the propriety of taking a national model as you've done and then inputting that into a county-specific model as Professor Cutler has done?

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A. Yes. I believe the national model is appropriate. Again, because marketing strategy is a national phenomenon, the national data are a reliable way to ascertain the relationship between marketing and sales.
I have used the same methodology, for example, in the Neurontin matter concerning Kaiser. We used a national model to estimate the relationship between marketing and sales and applied that to a single healthcare system.
Q. So if marketing is, in your view, nationally done and substantially similar, why is there a difference in shipments on a county level the way Professor Cutler's modeled it?
MR. SOBOL: Objection, scope.
A. This of course is the subject of Professor Cutler's report, and I -- I'm not sure as I sit here I could tell you exactly the factors, but it is obviously counties are situated differently in ways that he captures in his cross-sectional model of harms that could absolutely affect the

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shipments in that county, conditional on marketing.
BY MR. ROTH:
Q. Put another way, though, you would not expect differences in shipments across counties to be caused by marketing where you presume all marketing is national in scope?
MR. SOBOL: Objection.
A. I don't believe that that's the right way of looking at it. So if there's a specific relationship between marketing and sales and -- it could well be that counties start at different levels of use, and so the incremental effect of those relationships, as you see in Professor Cutler's analysis, materializes differently in those counties.
That doesn't mean the effect of marketing was different. It's just the baseline was different.
BY MR. ROTH:
Q. But I think you said that's an issue you would defer to Professor Cutler. You don't have an opinion on how your national model plugs into his county model

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and why the differences may occur in shipments?
MR. SOBOL: Objection.
A. It's my opinion that it's appropriate to take my national estimates. National-level analysis is the most robust analysis. It's the place where the data are really reliable. I think it's appropriate for Professor Cutler to use those estimates in the way that he has.
BY MR. ROTH:
Q. But you have no opinion that explains why we may be seeing variation between county-level shipments in his model despite him using your national model on marketing?
MR. SOBOL: Objection, asked and answered.
A. I do not have an opinion specifically on that, no.
BY MR. ROTH:
Q. You do not attempt to link any specific prescription to any specific defendant's marketing; is that fair?
A. Are you asking me whether I'm

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looking prescription by prescription, these ones were caused and those ones were not? The analysis -- the but-for analysis is a world that did not occur, of course. Would you agree?

The but-for world where the marketing didn't happen, didn't happen. So my analysis can tell me about the correct aggregate amount. It does not identify one prescription at a time.

Q. Okay. Yeah. Just so the record is clear, we've been through this, but you did an aggregate model. You didn't build it from the ground up on a prescription-by-prescription, detail-by-detail basis?

MR. SOBOL: Objection.

A. Right. If I may, the -- I did an aggregate model. The aggregate sales of course are the sum of individual prescriptions, but I am looking at the national level at total marketing on total sales.

It's not that it's unknowable what those prescriptions were underneath the

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sales data. That's not the -- that's not the challenge. The challenge is a conceptual one.

The but-for scenario didn't happen, so I cannot say precisely which prescriptions would not have been written, only that there is some group of them.

BY MR. ROTH:

Q. I know you said earlier you looked for manufacturer-specific detailing notes and marketing information. Did you find or learn of any manufacturer-produced data on detailing to specific doctors within Summit or Cuyahoga County?

A. I don't recall.

Q. And it's fair to say if that does exist, it's not something you reviewed or relied on for Attachment B?

MR. SOBOL: Objection.

A. I did not use individual physician-level data, no.

BY MR. ROTH:

Q. And individual physician-level data, as you may have used in other cases, would be drug specific and doctor specific,

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correct?

MR. SOBOL: Objection.

A. Well, it depends on really what you're talking about. When I have had individual physician-level data in the past, they are sales data. So again, I think the challenge is not disaggregating the sales data.

There are products that exist; sometimes they require subpoenas to get them, but there are products that exist that allow us to look at prescribing at a physician level, but not at detailing at a physician level. So those data I have not used because I have not seen them.

Q. Well, but, for example, an individual manufacturer may keep detailed call notes of the doctor visits that their sales representatives engage in, correct?

A. Well, I have seen call notes in the past, and I have always found them to be unusable.

Q. And why is that, out of curiosity?

A. They often do not include

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provider identifiers, so they can't be linked to other data. They are incomplete, and they -- they are often produced -- so incomplete in the sense of the call notes have a lot of blank fields, and they're often produced for short time periods.

Q. But you didn't look at any individual manufacturer call notes in this case in conjunction with your expert report or opinions?

A. I looked to see if there was a source of complete data for -- in order to do such an analysis, and my staff worked with counsel to identify documents or databases and did not find any.

Q. Pivoting back to Professor Cutler for one more second. Have you worked as an expert in other cases where you've only modeled causation and then another expert has taken that forward and put into it a damages model as Professor Cutler has done here?

A. Yes.

Q. And what case was that or cases, if there's more than one?

A. Yes. In Neurontin, I did the

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same, in that order. In other cases I've done the reverse where I've done damages and someone else has done causation.

Q. Okay. And in Neurontin or those other cases, whether you were on the causation side or the damages side, have you before encountered the issue you have here where you have a national model and then a localized model communicating with each other to calculate damages?

MR. SOBOL: Objection.

A. Yes. As I noted earlier, in Neurontin, I used a national model to connect to damages for Kaiser.

BY MR. ROTH:

Q. And the damages -- you used a national model, but what was the damages model based on? What was it localized, or was it also national?

A. It was localized. It was based on Kaiser.

Q. Based on a single company it sounds like you're saying. When you say Kaiser, what do you mean?

A. Yes, that's right. Kaiser was

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the plaintiff in that matter.

Q. Right. But that wasn't a model of geography. That was a model of damages to a particular company's sales, I would assume?

MR. SOBOL: Objection.

BY MR. ROTH:

Q. So for a typical -- an insurer, right. Kaiser is an insurer? Am I right about that?

A. Kaiser is a group health plan, so it is both a delivery system and an insurer, all rolled into one, and it is geographically distinct.

So Kaiser is not like United. It is not everywhere diffusely. It is largely in California and the Pacific Northwest with a few smaller sites elsewhere.

So again, those were national estimates and those were connected to damage calculations for a particular payer and delivery system.

Q. And do you recall how they were connected in that case? Were there any kind of localization factors taken into account or any way to differentiate the national level

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marketing from where the damages were being calculated?

A. As I sit here, I can't recall all the calculations. I believe, again, I produced the same kinds of but-for percentages and passed those along to the damage model.

Q. Okay. Other than the Kaiser case, can you think of any other examples like that one?

A. Not absolutely, but it wouldn't surprise me if I had done something like this before. I have been involved in some state cases. I just can't recall.

Q. Okay. What is regression analysis?

A. Regression analysis is a statistical methodology that uses data to try to understand the relationships among variables, and in particular, to identify the effects of certain explanatory variables on some dependent variable of interest.

Q. And what is a time series regression?

A. A time series regression is a

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model that looks at these patterns over time, so how -- how changes in these explanatory variables over time explain changes in the dependent variable over time.

Q. Your direct model in this case is a time series regression?

A. That's correct.

Q. When is it appropriate to use a time series regression model?

A. As in cases like this one where there are dynamic relationships among the variables of interest, and what I mean by that is that marketing has an effect that is path dependent. It depends on what happened in the last period as well as this period.

Q. What are the other types of regressions you could run, apart from a time series regression?

MR. SOBOL: Objection. You mean like here or like is she capable of?

THE WITNESS: I was going to ask you that question.

BY MR. ROTH:

Q. Generally in the world --

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generally in the world, you've got a time series -- so the way I think about this, right, you've got regression analysis, and one type of regression analysis is a time series regression, okay? Are you with me so far?

A. Okay. I'm with you.

Q. What are the other types of regression analyses that one could perform? I'm not asking specific to this case. Just in the universe.

A. There are cross-sectional regressions, panel data regressions. There's machine learning.

Q. Okay. And what is a cross-sectional regression?

A. A cross-sectional regression is like the one we run in the indirect model, which is looking at a set of observations where there's no time dimension. We're just looking across observations at a point in time.

Q. That Datta and Dave article we looked at, how would you classify that regression they ran?

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A. That's a panel model.

Q. Okay. And what --

A. They call it longitudinal, but I would call it panel.

Q. And what is a longitudinal or panel model, assuming those two things are the same?

A. It has multiple observations per unit of time, but also multiple units of time.

Q. And when is it appropriate to use a cross-sectional model?

A. Well, I think it's sort of hard to say in general, but, I mean, it's hard to say without being reductive. We run cross-sectional models when we want to understand cross-sectional relationships. So there may be things like gender, for example, that typically don't vary over time. I should say sex doesn't vary over time.

So we may want to understand the relationship between sex and wages. We would run that cross-sectionally. That's not something where we necessarily need a time dimension.

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So cross-sectional models are often used for these kinds of immalleable features that we're trying to understand as opposed to things that can change.

Q. When would it be appropriate to use a panel data model?

A. You know, in theory, you can answer many of the same questions with all of these models, but a panel data model allows one, as we were looking at with the Datta and Dave paper, allows one to understand the effects of the individual units, particularly in the way that they do, which is mostly by looking at the variance around those individual units as opposed to the characteristics of the physicians, and looking at decomposing that -- that variance against something that's operating in a time series way and being able to tease those two things apart as they do.

Q. Did you consider running either a cross-sectional model or a panel data model in this case?

A. My belief is that an aggregate time series model is the appropriate model

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for the question at hand, so as I have done in other cases, I selected the aggregate time series model.

MR. SOBOL: You both just meant on the direct side, right?

MR. ROTH: Correct. Good clarification.

BY MR. ROTH:

Q. Why did you believe that the aggregate time series model was the appropriate model for your direct approach for the question at hand?

A. Because, as I mentioned in describing the general purposes of these alternative types of models, the key relationship I'm interested in is this path-dependent relationship between marketing and sales, and aggregate time series model is -- zones right in on that. So that's exactly what it's looking at.

It's not trying to understand some of the mechanisms that Datta and Dave are looking at. I want a model that will capture this total effect as reliably as possible.

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Q. Do you agree with the statement that although a time series correlation may be striking, it does not necessarily determine a causal effect?
A. With any regression model, economists will need to use theory and tests and judgment to determine causality. So there may be time series relationships that are not causal, yes, that is correct.
Q. And do you agree that when there's a slow-moving trend in one variable through time, it is very difficult to infer its causal effects on another variable?
MR. SOBOL: Objection.
You can answer.
A. I believe that you're describing again the well-known limitations of any time series model, and there are ways to examine those challenges.
So again, we first have to start with an appropriate theoretical model. Of course, you could put two variables that trend together in a model and there's no sensible relationship, and clearly that would be spurious.

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On the other hand, marketing is clearly designed to increase sales, so we start with the theory. And in developing the model, we examine the kinds of time series questions that you just raised with that comment.
BY MR. ROTH:
Q. I mean, in some ways the conclusion that marketing influences sales is tautological, right? If you're marketing correctly, you should be increasing sales.
MR. SOBOL: Objection.
You can answer.
A. I don't think that's tautological. It is -- to an economist, again, we would start with economic theory, and if you take the theory of profit maximization and put marketing in that context, it would only make sense for marketing to be undertaken if it increased sales.
I think as a noneconomist, if you grab someone on the street in Boston and ask them why do companies market, they would agree with that basic premise, right? So

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that's -- that's the starting place.
It's not where we end the discussion, but I wouldn't say it's tautological. I would say it's theoretically consistent.
BY MR. ROTH:
Q. As an economist, if companies are rational actors, they're not going to spend money on marketing if they don't have some sales increase.
A. I would agree with that statement, yes.
Q. What are the standard diagnostic tests you perform in running time series regressions?
A. In this model, of course, you can see that we looked particularly about the fit of the model over time and where -- I'm picturing in my head the chart with Model A on it where we had a single coefficient for promotional effectiveness, and clearly we were departing from the underlying data, so those kinds of tests we conducted Wald tests, two-dimensional Wald tests to examine the appropriate turning points, and likewise,

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because part of this time series model of course is the stock of marketing and its appropriate depreciation rate, we conducted statistical tests around that as well.
Q. So you answered about this model, which I want to get to.
A. Sure.
Q. But I'm talking generally when you do time series models, what are the standard diagnostic tests you might be perform, whether or not you actually did it in this case?
A. Right. I don't believe that they're reported here, but early on in looking at the data, we looked for -- we looked at a Dickey-Fuller test, which is basically testing for unit roots.
I'm thinking about the simple explanation goes to what you said before about two slow-moving trends and whether there might be spurious correlation, and we found that those concerns were not warranted based on the Dickey-Fuller results.
MR. SOBOL: Can you spell that?
THE WITNESS: Dickey,

D-I-C-K-E-Y, dash, Fuller.
MR. ROTH: F-U-L-L-E-R?
A. Yes.
BY MR. ROTH:
Q. What is nonstationarity?
A. Nonstationarity relates to that unit root. It has to do with the trends -- that these two trends are moving together.
Q. The mean or variance of the variable is not constant over time?
A. It's -- again, it's related to the way the variable of interest and the right-hand side variable are regressing together, so it has to do with the variance over time.
Q. And why is nonstationarity an issue with time series models?
A. If you have this problem, which again, we do not, then you can get spurious results.
Q. Do you know when your team or you performed the Dickey-Fuller test?
A. I believe it was early on in the analysis that we were doing.
Q. Okay. And do you have the

results of those tests somewhere that you could produce to us?
A. I do not.
Q. And why is that? Is it a computer model test that...
A. Generally we don't save the log files for those kinds of tests.
Q. Okay. Could one be performed using the backup data you've produced?
MR. SOBOL: Objection.
A. Yes, I believe so.
BY MR. ROTH:
Q. Do you know if the MME prescriptions in your model are stationary?
A. As I sit here, no.
Q. Do you know if the stock of detailing variable is stationary?
A. Again, as I sit here, no.
Q. And would the presence of nonstationarity lead you to overstate the impact of promotion in your direct model?
A. Well, again, if the -- if there was a unit root problem, then it could overstate the results, yes.
Q. And I assume because your

Dickey-Fuller test showed no unit root problem, you did not make any effort to correct for nonstationarity?
A. That's correct.
Q. What is autocorrelation?
A. Autocorrelation is essentially when the residuals from one time period are correlated with the residuals from the next time period, so autocorrelation from period to period.
Q. And autocorrelation can overstate the impact of a predictor variable?
A. No, that's not quite correct. Autocorrelation can affect the standard errors. It does not bias the coefficient.
Q. Could the presence of autocorrelation lead to an overstatement of the impact of an independent variable?
A. No, the presence of autocorrelation could lead to an overstatement of the statistical significance of an independent variable, but not its effect.
Q. Did you run any tests to detect autocorrelation in your direct model?

A. I believe there were some tests for autocorrelation also early on when we were beginning our work, and we found that, particularly in the late period, that while there was some early autocorrelation, that the autocorrelation goes away in a later period of the data, and we did not correct for it.
Q. Is that a Durbin-Watson test?
A. I believe that is a Durbin-Watson.
Q. Do you have the results of that test readily available, or no, because you didn't save the log file?
A. As far as I know, the log file was not saved.
Q. But again, that's a test that could be replicated on your model with the backup data that you've provided?
A. Yes, it could be.
Q. When is it appropriate to aggregate versus utilizing cross-sectional information in putting together a regression?
MR. SOBOL: Generally?
MR. ROTH: Correct.

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A. Well, aggregation has a number of advantages in specific contexts. I would say -- go back to my first answer, which is we are interested here in an aggregate question. If you were interested in an individual question, you wouldn't aggregate.

So we are at first principles interested in the -- I am interested in the impact of opioid marketing in this class on sales, and so I start there.

Aggregation can provide benefits in that it cuts down on certain kinds of noise, and it also -- it steps away from certain kinds of endogeneity problems, but I'm sure we will talk more about -- but we talked a little bit about --

BY MR. ROTH:

Q. How did you know?

A. -- in terms of Datta and Dave, the endogeneity problem that they're interested in is that physicians who have a propensity to prescribe your drug are the ones you detail. But when we aggregate, when we go up to the aggregate level, we don't have that same endogeneity problem, so...

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Q. Thank you for saying endogeneity before I did so I made sure I got it right. And we will talk about it.

But is it also true that aggregation can sometimes mask patterns in the data?

A. Well, yes, but you have to be interested in those patterns for that to be a problem. So if, in fact, there are patterns in the data, my task as I understand it is to look at the aggregate effect of marketing, so that's just not a question that I was particularly interested in here.

It's true that an average effect will mask differences, if there are any.

Q. Okay. So going back to paragraph 11 of your report.

A. Yeah.

Q. This is your summary of opinions. Do you see that?

A. Yes.

Q. And you also have a handy chart, which we'll talk about later, but I just want to focus on paragraph 11 first.

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A. Yeah.

Q. So the last bullet on page 8 says: Using econometric models, I demonstrate that I can reasonably identify the extent to which the sale of prescription opioids measured by the number of milligrams of morphine equivalents, or MMEs, was caused by any quantum of the defendants' promotional efforts that counsel can prove was unlawful.

Do you see that sentence?

A. I do.

Q. And we'll get more into the specifics on that, but how is that so, where your assumption was that everything was unlawful? How could you particularize your model to any quantum that counsel proves?

MR. SOBOL: Objection.

A. Sure. My Table 3 does that, for example, by backing out individual defendants and saying, okay, let's just assume that, in fact, defendant X was not involved. So it can be done that way.

It could be done propositionally. It could be done by saying, no, it wasn't 1995; it really didn't start

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until 2000. That's what I mean by "any quantum," is that we could divide the marketing in any measurable way over my model.

BY MR. ROTH:

Q. What if the quantum of promotional efforts that counsel proved unlawful was influencing key opinion leaders to change prescribing standards, how would your model be used to evaluate conduct in that situation?

A. I haven't been asked to look at that, so I'd need to really give that some thought. I wouldn't call that a quantum. I would call that something else, and I'm not going to make up words, but that's more of a sort of qualitative piece. But in theory, that's possible. I have not looked at that.

Q. And that's a good clarification. When you say quantum, you mean quantitative, not qualitative, right?

A. That's what I meant, yes.

Q. So you could take out specific defendants or percentages, but you could not modify your model using a qualitative test

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for unlawfulness to determine what the impact is?
MR. SOBOL: Objection.
A. I would not conclude that without giving some thought. I'm sure it couldn't be done for every qualitative example that you could come up with, but I think that there are ways of doing it qualitatively, as I, again, did in the Neurontin matter, looking at promotion to psychiatrists as opposed to other physicians.
BY MR. ROTH:
Q. But since you have an aggregate national model with aggregate detailing, is there a way to go, for example, and figure out where the details only to dentists were if the court concludes that that was the unlawful activity as opposed to detailing writ large?
A. I'm not a hundred percent sure about dentists, but as I used in the Neurontin matter, there are detailing data available that would allow you to look nationally by specialty.
Q. But the detailing data you used

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in the Neurontin matter for that exercise is not the same detailing data you used in this matter for your direct model, correct?
A. It's not exactly the same because it was disaggregated by specialty, but I believe those -- that is possible to disaggregate by specialty. I've not done that here.
Q. And you haven't even tested whether it can be done yet, right?
MR. SOBOL: Objection.
A. I have not.
BY MR. ROTH:
Q. I'll give you a quantitative measure. What if the court concludes that any detail over five minutes in length were presumed unlawful, but anything shorter than that isn't? How can you quantify the impact of the over-five-minute visits in your model?
A. As I sit here, I don't know because I haven't thought about it. Clearly I would need some data on the length of details.
Q. We'll come back to this, I promise, but back to paragraph 11 for a

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minute.
So on page 9, the bullet says: Based upon my analyses and assumptions from counsel about the extent of promotion that can be proven to be unlawful, I can reasonably identify approximately [redacted] of MMEs during the period of my analysis as caused by unlawful promotion.
Did I read that correctly?
A. You did.
Q. And the [redacted] is the direct number, and the [redacted] is the indirect number from your models?
A. That's correct.
Q. Okay. And then if you look at paragraph 75 -- and we talked about this earlier already. But paragraph 75, which is on page 50 under Calculation of But-For MMEs.
Do you see that?
A. Yes.
Q. You say: I have been instructed by counsel to assume in my but-for scenarios that the fact finder, judge or jury, finds that all or virtually all promotion by the manufacturer defendants from

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1995 to present was unlawful.
Do you see that?
A. Yes.
Q. And then after the parentheses, it says: Thus, to calculate impact for the purpose of damages beginning in 2006, I modeled a world in which this promotion did not occur, i.e., but-for promotion equals actual promotion for opioids, less all promotion for opioids by the defendants and their surrogates.
Do you see that?
A. I do.
Q. And then in Table 2 on the next page, there's actually a note that says: The percent of MMEs attributable to challenged promotion is calculated as the difference between predicted actual and predicted but-for MMEs, assuming all defendants' promotion is set to zero starting in 1995 divided by predicted actual MMEs.
Do you see that?
A. Yes.
Q. So your model assumption is actually, not virtually, all promotion by

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defendants is unlawful; it's that all promotion by defendants is unlawful?
A. Yes. I guess the -- sort of the legal formulation of that, I'm repeating there when I say all and virtually all. I'm not sure what virtually all would be quantified as, 99%, but I do all, yes.
Q. Okay. And does that not equate to assuming that all MMEs prescribed due to defendants' promotion were medically unnecessary?
A. No, that does not equate to that.
Q. So in your model, you could have unlawful promotion that leads to medically necessary scripts still?
A. I was asked to quantify the impact of the alleged unlawful promotion, not to examine that question about whether that prescription itself was medically unnecessary, so -- so it's something I haven't looked at and I don't believe it's related to my charge.
The fact that the promotion was unlawful to me does not equate to the fact

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that a prescription was medically unnecessary.
Q. So if promotion, whether lawful or unlawful, results in a medically necessary prescription, how does that prescription cause damage?
MR. SOBOL: Objection, scope.
A. I'm not a lawyer, as you know. And sort of what the theory of liability is and what -- what plaintiffs can recover for and what they can't is -- I do not know.
I have only been asked to examine the extent to which this unlawful conduct caused sales.
BY MR. ROTH:
Q. Okay. You're not a lawyer, but you're a good economist. You've testified a lot about causation and damages, okay, and you're familiar with what a but-for world is, right?
A. Yes.
Q. You have one here?
A. I do.
Q. So how does your but-for world treat medically necessary prescriptions?

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A. Again, this is --
MR. SOBOL: Objection.
But go ahead.
THE WITNESS: Sorry.
A. The model treats the right-hand side variable as the thing that will be proven to be unlawful, and any sales gained from that unlawful conduct as subject to recovery. This I know as a, thank you, good economist and someone who's done that, that downstream of my analysis there's a damage number that plaintiffs I believe will try to recover.
So as an economist, to me, the theory is that any gains, whether or not they resulted in medically necessary prescriptions, are subject to recovery. As an economist, that seems like a reasonable theory if we wanted to deter fraudulent and misleading information. This is the same analysis that I did in the Neurontin case.
BY MR. ROTH:
Q. Stated differently, your model will calculate causation by defendants' marketing even for medically necessary

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prescriptions?
A. It does not distinguish. And to be clear, whether or not there were medically necessary prescriptions caused by the misconduct, I can't say for sure.
Q. And as an economist, is that not something you think you should take into account in your but-for world where you're opining that but for the defendants' conduct, fewer of these MMEs would be out in the world?
A. Absolutely not. Again, as an economist, to me, if the allegations are true, I can see a strong economic rationale for ensuring that liability is attached to all these ill-gotten gains from the alleged misconduct.
Q. But there is a parallel world where a manufacturer may promote lawfully and that lawful promotion would result in medically necessary prescriptions, correct?
MR. SOBOL: Objection.
A. I -- you have a lot of parallel worlds I've noticed, but yes, I think we agreed at the beginning of the day that there

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is such a thing as lawful marketing, and it does generate sales.

Some of those sales may be medically necessary, some may be medically unnecessary, even if there's no unlawful conduct.

BY MR. ROTH:

Q. I asked some of these questions, but I did promise I'd come back.

How would your model work if the court finds that only detailing visits where the representative spoke about addiction risk were unlawful?

A. I don't know the answer to that question. I have not thought about how one could parse that out, so I don't know as I sit here.

Q. You did mention time could be quantified, so I guess to clarify, would you be able to calculate causation if the court found, for example, that only detailing that happened between 1996 and 2000 were unlawful?

A. Yes, my model is capable of doing any combination of manufacturer and time.

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Q. What about drug?

A. And drug.

Q. Okay. So you could do -- you could take out manufacturers, right?

A. Yes.

Q. You could take out drugs?

A. Yes.

Q. And you could take out years?

A. Yes.

Q. Okay. Beyond that, is there anything you can take out of your model?

MR. SOBOL: Objection.

A. Well, as I said earlier, I believe that it's possible to take out physician specialties.

BY MR. ROTH:

Q. Right. And we talked about that. But you're not certain it can be done, and you haven't tested it yet?

MR. SOBOL: Objection.

A. I haven't tested that.

BY MR. ROTH:

Q. What if the court finds that only off-label marketing was unlawful? Is there any way your model can be adjusted to

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account for just the unlawful off-label detailing?

A. I assume that you're talking about specific off-label messages. Again, I haven't -- I haven't thought about how the detailing itself could be parsed in that way. There would need to be another source of information for that to be possible.

Q. You need a different dataset basically?

A. Yes. The thing with detailing is that it's a face-to-face visit, so we can see what messages the detailer brought on paper with them but not what came out of their mouths.

Q. What if the court finds that only journal advertising were unlawful? How would your model account for that?

A. Well, as I believe I say in my report, the journal advertising data is very spotty for these drugs, so I've not included that as a separate factor. It's already out of my model. I would have to give that some consideration.

Q. Okay. If we look at

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Attachment D, which is towards the back, I want to go to page D6. And there's a section at the bottom --

MR. SOBOL: I'm sorry. Wait.

MR. ROTH: D6 of Attachment D.

MR. SOBOL: Is it the table?

MR. ROTH: No, it's the text. It's the technical write-up of the regression.

THE WITNESS: Yeah.

MR. ROTH: I feel like it's always Attachment D in every case, by the way.

THE WITNESS: Is it? Interesting.

BY MR. ROTH:

Q. Are you in Attachment D, D6?

MR. SOBOL: It's just the same attachment.

A. I am.

BY MR. ROTH:

Q. It's all in the same report, right?

A. You didn't notice? Yeah.

Q. Well, Tom is involved for sure.

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All right.
So looking at Attachment D, page D6. This may be from one of the same attachments. I don't know. Do you see there's a section that says Comcast Considerations?
A. Yes, I do.
Q. What is the reference to Comcast there?
A. Well, again, I'm not lawyer, but I understand that there was a case involving Comcast, and that the -- what it concerns, again, from a layperson's understanding, is about the ability of the damages as presented to the court to conform to different conclusions about the but-for scenario.
Q. Essentially the issue we've been talking about for the last --
A. The issue we've been talking about.
Q. And why were you concerned about the application of Comcast to this case?
MR. SOBOL: Objection, assumes

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a fact not in evidence.
BY MR. ROTH:
Q. Assuming you were.
A. As you recall, the last part of my assignment was to report on how my conclusion would be different if there were different considerations with regard to who's in, who's out by defendant, for example. So yes.
Q. Okay. I'm trying to streamline here because we've covered more ground --
A. We're going to cover 14 hours no matter what --
Q. That's true.
A. -- so streamlining may be good for you, but it's not good for me.
MR. ROTH: I'm having fun. I think you are too.
THE WITNESS: Of course.
MR. LONERGAN: What about us?
BY MR. ROTH:
Q. Do you agree that your model does not measure the impact -- we went over this. I'm not going to ask that again. Strike that.

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Could you have modeled an individual manufacturer separately?
MR. SOBOL: Objection, asked and answered.
A. It was not something I attempted to do. I think mechanically it is possible. But as I noted, one of the reasons for using an aggregate time series is that we smooth over a lot of noise in the data, so I don't know whether an individual manufacturer-level model would be feasible.
BY MR. ROTH:
Q. Okay. In a but-for world, where all of the unlawful detailing, which is your assumed all defendants' detailing, were replaced with lawful detailing, would there be any change in overall prescribing?
A. Sorry. I just -- so the model doesn't itself have a presumption about lawful and unlawful. The but-for scenario is where that presumption is incorporated, so the model is the model.
Q. I asked a bad question and you properly called me on it. Let me ask a better question.

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If we assume that all unlawful detailing is lawful, then the actual prescribing and the but-for prescribing in your models would be equal to each other?
A. Yes, that's correct. Those two predicted values would be identical.
Q. So the percent of MMEs attributed to unlawful detailing in that scenario would be zero percent.
A. Yes. If marketing were the same in both scenarios, then there would be no difference.
Q. Assume for a minute that a manufacturer's detailing is found to be unlawful but it did not engage in any of the other marketing misconduct alleged by plaintiffs with respect to the key opinion leaders, journal advertising and the other factors.
How would your model account for harm for that specific manufacturer?
MR. SOBOL: Objection.
A. In my opinion, that would be a legal question because, again, all the manufacturers are operating in the same

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ecosystem. According to the complaint and everything I know as a health economist, the effects of one manufacturer's unbranded marketing -- I use that to refer to the guidelines and those kinds of activities -- will spill over on to another manufacturer, and I don't know whether it would be appropriate to pull that out or not.

BY MR. ROTH:

Q. That's a long answer. I want to -- I think I asked a more specific question.

A. Sure.

Q. So if detailing is unlawful --

A. Yes.

Q. -- and let's say also the other stuff, okay, key opinion leaders influencing standards of care is also unlawful, and a manufacturer just detailed, they're going to have the same percentage of liability in your direct model whether or not they engaged in the other unlawful conduct, correct?

MR. SOBOL: Objection.

A. Yes, that's true. Although it's true in terms of what I calculate in

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Table 3. Just to be clear, I don't have an opinion on liability. That's a legal matter. But what I do in Table 3 is I say, okay, well, what would happen if we said the detailing by Purdue were lawful, what would happen there?

So whether or not that quantum is exactly what liability is, I don't -- I don't really know how the court is going to see that, and so that's why I don't really know if you would need to say, well, some of why your detailing was so productive was caused by somebody else's activity. I don't know whether it would make sense to back that out.

BY MR. ROTH:

Q. So let's take the opposite.

A. Yeah.

Q. Someone's detailing is entirely lawful. There's no issue there. But they've influenced the standards of care through key opinion leaders, they've paid off doctors, they've done all of the parade of horribles that the plaintiffs allege, and the court finds that that in fact is unlawful. In your

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model, that manufacturer has no liability, correct?

MR. SOBOL: Objection.

A. Well, again, my model is looking at the aggregate causation between marketing and sales; it is not designed to assign liability to individual manufacturers nor, again, am I certain how counsel or the courts would do so.

The purpose of Table 3 is to show that I can back out individual levels of detailing, not to assign liability. So I -- I don't know exactly how that would proceed, even -- even without having these variable assumptions across defendants. I have not looked defendant by defendant at something like liability.

BY MR. ROTH:

Q. Okay. So let's look aggregate.

If for all the manufacturers the conclusion is that the detailing is entirely lawful, but the manufacturers engaged in other conduct that the court finds is unlawful, what would the result of your model be in that world?

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MR. SOBOL: Objection.

A. I would have to give it some thought, but again, my preferred model ultimately captures the effect of all that other stuff that we're calling as really is the what happens -- in part, a chunk of it is what happens to the promotional effectiveness after the first turning point and before the second turning point. And so in theory, one could look at that, but it would really depend on the specific set of facts.

BY MR. ROTH:

Q. It would require a new model probably?

MR. SOBOL: Objection.

A. I don't know that it would require a new model. It would require a new but-for analysis.

BY MR. ROTH:

Q. Back to your body of your report, paragraph 64. You say: The econometric analyses serve two purposes. First, they indicate that in economic terms there is a causal relationship between the defendants' promotion and prescriptions of

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opioids so that if the allegations of misconduct are proven true, impact can be found.

Do you see that?

A. Yes.

Q. But you actually didn't assess specifically a causal relationship between promotion and prescriptions, right? Those are not the two variables on your X and Y axis?

MR. SOBOL: Objection.

A. Well, I look at the stock of detailing, which I argue and believe is a reasonable proxy for promotion. It is not, strictly speaking, all promotion. To the extent that it is measured with error, it understates the effect of promotion.

BY MR. ROTH:

Q. If we wanted to be precise, though, what your model actually shows is a correlation between detailing and MMEs?

MR. SOBOL: Objection.

A. Well, as we talked about earlier and will no doubt talk about again, any regression analysis can have a causal

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interpretation or not, depending on a number of factors.

I interpret this regression analysis as showing causation between marketing and sales, and it does, in fact, use detailing contacts as the measure of marketing.

BY MR. ROTH:

Q. And if we want to be even more precise, when we're talking about defendants detailing, we're talking about all detailing without distinguishing between lawful and unlawful as we've talked about?

MR. SOBOL: Objection, asked and answered.

A. For the purposes of my analysis, I've been asked to assume that all detailing in this period was unlawful, so that distinction is not relevant.

BY MR. ROTH:

Q. So your model does not analyze causation between the false promotion as alleged in the complaint and the number of MMEs prescribed?

MR. SOBOL: Objection.

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A. I would disagree. That is exactly what my model does. Again, we can agree that I have not separately proven that that detailing was unlawful, but I understand that counsel for plaintiffs intend to prove that, and so I have undertaken to examine the causal effect of that allegedly unlawful conduct.

BY MR. ROTH:

Q. Which is all promotion by defendants?

A. Which is all promotion by defendants from 1995 to the end of my data.

Q. And when does your data end?

A. Mid 2018.

Q. Okay. Do you plan on updating it if we go to trial in 2019 to take us through today?

MR. SOBOL: Objection.

A. I haven't been asked to do that. I don't know if I would be asked to do that.

MR. ROTH: Why don't we take a break, because I realize we've probably covered some of these next

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questions and I can streamline.

THE WITNESS: Okay.

THE VIDEOGRAPHER: The time is 10:58 a.m. We're now off the record.

(Recess taken, 10:58 a.m. to 11:13 a.m.)

THE VIDEOGRAPHER: The time is 11:13 a.m. We're back on the record.

BY MR. ROTH:

Q. Professor Rosenthal, if you would please turn to paragraph 59, which is on page 42. All right. So we're going to go step by step here.

A. Okay.

Q. You say: My primary dependent variable, the outcome to be explained, is the number of MMEs for all drugs at issue in this matter.

Do you see that?

A. Yes.

Q. Okay. Why did you look at MMEs as opposed to prescriptions or some other measure?

A. Sure. Because, as I note in this paragraph, the intensity of the medicine

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of promotion are correlated?
A. Well, as I mentioned, when I looked at the IQVIA data for journal advertisements, direct-to-consumer advertising, sampling, there was very little data there. I have no reason to believe that they're just not measuring it. It may be that there are some kinds of advertising that we see in the marketing budgets that IQVIA doesn't capture. But to the extent that the IQVIA data are complete, it was not really possible to do a correlation analysis because there was so little data for these other tools.
Q. So when you say it's a reasonable expectation that other forms of marketing follow detailing, that's really just an assumption based on your experience with other drugs in other cases?
A. It's based on my experience with very similar kinds of analyses with other drugs. And again, I cite to Dr. Perri's report at the beginning of this where he talks about the coordination of marketing mechanisms, so it's very consistent

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with his opinions as well.
Q. Yeah. But to be clear, that's an assumption you're making that's not supported by any specific work you've done to confirm it's true that detailing and other forms of promotion are correlated for opioids?
MR. SOBOL: Objection, asked and answered.
A. Again, the analysis -- the correlation analysis was not possible here, so I'm relying on my past experience and Dr. Perri's expertise.
BY MR. ROTH:
Q. Okay. Then you say: Third, alternative measures of promotion that I could obtain from available sources have substantial missing data, e.g., estimates of payments to pain advocacy groups can only be obtained from the records of some, but not all manufacturers.
Do you see that?
A. Yes.
Q. And that's what we've been talking about.

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A. Yes.
Q. Are you certain that every manufacturer in this case has made payments to pain advocacy groups for opioids?
A. Well, given -- that's -- it's hard to be certain about something for which I have incomplete data, so I -- there are a number of documents that I cite to that show these kinds of payments, and I believe other experts have tracked these payments as well.
But am I certain that every defendant has evidence of that type? No, I'm not certain.
Q. And then you wrap up this paragraph saying: Note that in this case there appears to be substantial evidence that through means other than promotional spending, the defendant manufacturers fundamentally changed opioid prescribing standards. The direct approach does not calculate the efforts -- the effects, sorry -- of the nonpromotional marketing and is thus conservative.
Do you see that?
A. Yes.

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Q. But that's not universally true for all manufacturers, is it?
MR. SOBOL: Objection.
A. Again, my opinions here really are to look at the market as a whole, and even if there were a defendant that did not incur this kind of spending, the effects of changing things like guidelines would -- would flow through to everyone's drugs, right.
So these are sort of broad changes in the environment of prescribing, and so again, I don't have an opinion on the liability question of whether there's a defendant who has not undertaken the unbranded advertising, whether they therefore should not be liable for its effects. I don't know the answer to that.
BY MR. ROTH:
Q. What if a manufacturer engages only in limited detailing and not other types of promotional activities? It would not be conservative for that manufacturer to only look at detailing, correct?
A. The purpose of my analysis is

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not to assign liability to individual defendants. It's to look at the aggregate effect. So I don't know what would be appropriate. That to me seems like a legal question.

Q. Would it be conservative from an economic perspective if a manufacturer purchases an opioid product in, say, 2008 and engages in detailing but no other marketing?

A. I do not calculate any estimates at the individual defendant level, so I cannot characterize them as conservative or otherwise. I'm only looking at aggregate effects.

Q. Okay. I'm just trying to get at what you mean when you say the direct approach is conservative. It strikes me that for a defendant who didn't participate in the market ecosystem until late in the game and only detailed, it's actually the opposite of conservative the way your model calculates damages.

MR. SOBOL: Objection.

A. I believe that is inaccurate. My model does not calculate damages for any

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individual defendant, period.

BY MR. ROTH:

Q. Causation, sorry, I should have said.

A. So again, because I am not looking at impact for an individual defendant, we cannot characterize my analysis as conservative or otherwise for an individual defendant. It is for the market as a whole.

Q. Okay. So when you say in paragraph 56 that the approach is conservative, you mean on an aggregate basis it is conservative because it looks at detailing and not other things?

A. That's correct.

Q. Okay. Sort of implicit in that statement and other things you've said today is an assumption that all manufacturers market opioids the same way.

MR. SOBOL: Objection.

BY MR. ROTH:

Q. Do you agree with that?

A. I don't believe so. Again, I include in my model detailing. To the extent

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that there's variation in the way manufacturers detail, the specific details may generate more prescriptions or fewer, and my model captures the average effect. That's what the coefficients basically tell us is the average effects.

So there may be variation in there, but for the purposes of calculating aggregate impact, the average is appropriate.

Q. So for manufacturers who have detailing that's below average, they're being brought up to the average by the way you've aggregated the model in terms of causation?

A. Well, by definition, an average will be not the same as all the individual components unless there's no variation, and so there will be some who are brought up and some who are brought down.

It's my belief, as we talked about before, that this aggregate model is the most reliable model; because there's substantial spillover effects, because there can be noise in the data when we try to disaggregate it too much. I think for that reason, the aggregate model is preferable.

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Q. You know, though, that not every manufacturer markets products the same way?

A. I guess -- I'm not exactly sure how to answer that question. As we've talked about before, I am not a pharmaceutical marketing expert. I leave that to Dr. Perri. I think it's reasonable to assume that there is some variation in tactics and the like across manufacturers and perhaps across products.

Q. Well, let's look at one thing you do talk about. So there's a difference in the way promotion is engaged in by brand companies and marketing may be engaged in by generic companies, correct?

A. Yes, brand companies are primarily the ones that engage in marketing.

Q. A generic company might still detail but may just talk about price and formulary status?

MR. SOBOL: Objection.

A. Generally, manufacturers will not detail physicians for generics. They may have other sales force activities that they

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do that relate to price, but individual physicians are not generally making a decision about one generic versus the other. That decision happens at the pharmacy.
BY MR. ROTH:
Q. But Attachment C contains a slew of generics on that list?
A. That's correct. Some of them have contacts related to them. Some of them don't. Some of those contacts relate to marketing agreements that are really for brand drugs.
Q. So how do you square your testimony a minute ago that generics generally don't detail with the fact that you have a lot of promotional contacts in your model for generic drugs?
MR. SOBOL: Objection.
A. I believe I just squared it. I think a lot of those contacts relate to marketing agreements.
BY MR. ROTH:
Q. And so if there's marketing under a marketing agreement, that gets attributed to the generic drug, even though

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it may be different in kind than a branded drug promotional visit?
MR. SOBOL: Objection.
A. No. The marketing of a particular drug is identified, and if the drug is sold by a defendant manufacturer, even if it's detailed by a different manufacturer, that gets counted in my model. And then in Table 3, I take out those marketing agreement related drugs.
So -- so it's -- the marketing is associated with -- I mean, I look at aggregate marketing, so it's all in the aggregate marketing. But I do have a mechanism for pulling out marketing that's for someone else's drug.
BY MR. ROTH:
Q. So if that's the mechanism you're using, how are any of these detailing contacts being attributed to generic drugs in your model?
MR. SOBOL: Objection.
A. I think you misunderstand the nature of the model. The model uses aggregate MMEs and aggregate detailing, so

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there's not an attribution underneath that.
And furthermore, as we know, that detailing for the brand drug will spill over to the generic drugs too, and so it's entirely appropriate that the model allows that to happen.
Q. So maybe we're talking past each other.
I understand the model works that way.
A. Yeah.
Q. What I'm talking about, which we'll get to later, is your Table 3 allocates drugs to specific manufacturers, including generic manufacturers, and I'm just trying to understand how that works in a world where we agree that generic drugs generally aren't detailed.
A. So Table 3, it sits on top of a somewhat more complicated analysis, but what it in effect does is it takes the detailing associated with each of those defendants and treats it separately, depending on where we are in the table.
So, you know, at the top for

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Actavis, to the extent that Actavis has detailing in my data, the row that says, well, what would the damages look like or what would impact look like if Actavis' detailing was deemed to be lawful? Basically we've taken out their detailing, out of -- we've left it in basically in a but-for world. It happens because it's lawful.
So that's how -- that's how the allocation works, is in Table 3, it's by manufacturer.
Q. Okay. We'll get there.
A. Okay.
Q. But that's helpful.
If you look back at paragraph 55, I mean, you acknowledge that detailing is undertaken by the brand name drugs in the class, typically peaks during initial launch, and ceases shortly before or after the AB-rated bioequivalent generic drugs enter.
A. That's correct.
Q. And how does your model account for detailing at different points of a product's life cycle, close-to-launch

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detailing versus the period right before generic entry?
A. My model is an aggregate model, so I'm looking across drugs in the entire market, and those drugs are at different stages in their life cycle. And so the important input to my model is the level of detailing, not where it is in the course of a product's life cycle.
But we know that the bolus of detailing happens for these new products, and so that is incorporated into the data.
Q. So it's incorporated in the sense that you'll see more contact at the beginning of the life cycle than at the end of the life cycle?
A. That's correct.
Q. But the detailing that happens at the beginning of the life cycle could be qualitatively different than the detailing that happens at the end of the branded life cycle.
Would you agree with that?
MR. SOBOL: Objection.
A. I don't know that to be true.

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BY MR. ROTH:
Q. As an economist, I mean, when a product is launched, you would expect more detailing about clinical studies and things designed to promote a new product that physicians might be unaware of, right?
A. It may be that there is more of that sort of baseline information at the beginning.
Q. Right. And at the end of a product's life cycle, when the generics are about to come on the market, you might expect the detailing to focus more on things like price and availability and formulary status and things of that nature, right?
A. I have seen no detailing information that pertains to price. I can't say that it never happens, but I've certainly never seen that.
What that sort of -- what you've just described here is on the one hand saying, hey, there's this new drug early on, and don't forgot your old friend at the end, something to that effect. Those -- those differences are not relevant to the question

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of does the detail generate more MMEs.
So for my purposes, I really only want to understand does the detail generate more MMEs. And again, because I'm looking at the aggregate, the fact that some drugs are ending and others are beginning, that -- that sort of -- that mix, it may change a little bit over time, but I'll be looking across a set of drugs at different stages.
Q. Okay. But what I described might be relevant to the question of whether the detailing was lawful, correct?
A. I don't know what you mean by that.
Q. Right. So we've established this, I think, but just to try it one more time: Because your model is just focusing on whether detailing impacts the aggregate number of MMEs, you don't evaluate any qualitative difference in the kind of detailing that is occurring?
MR. SOBOL: Objection, asked and answered.
///

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BY MR. ROTH:
Q. Is that a fair statement?
MR. SOBOL: Asked and answered.
A. I -- you had a "because" at the beginning of that sentence, which doesn't make sense to me. I am not looking at the content of the detailing as we talked about this morning. I am assuming the plaintiffs will prove their case.
I understand that you think differently and you're trying to probe whether I've tried to disaggregate the detailing.
I have not tried to disaggregate the detailing by drug or over time. It is possible to do that, but I have not done that.
BY MR. ROTH:
Q. So in your direct model, just like all MMEs are created equal, all detailing contacts are created equal?
MR. SOBOL: Objection.
A. Again, I would acknowledge that there's variation in detailing and that my model captures the average effect.

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BY MR. ROTH:
Q. And it captures the average effect by treating each contact the same?
MR. SOBOL: Objection.
A. Well, I guess sort of an average effect means that sort of tautologically, I'm summing up all of the effects.
BY MR. ROTH:
Q. Does your model account for rivalrous marketing?
A. I'm so happy that we've gotten back to this.
MR. SOBOL: That makes one of us.
A. The aggregate model that I put forth is intended to essentially obscure the rivalrous marketing, so to the extent that marketing only moves people from hydrocodone to oxycodone or the other direction, whatever it is, that will show up as a noneffect in my model.
So I'm only looking at market expansion because the question I care about is market expansion.

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BY MR. ROTH:
Q. I'm not sure I followed your answer. So how does it show up as a noneffect if you're including that contact in your regression analysis, whether it was new drug promotion or rivalrous marketing?
A. I think the way you're looking at rivalrous marketing is a bit different than the way I would look at it. And this goes back to a conversation we had before where I think there was a little bit of a disconnect.
So it may well be that you go to the detail and what you want to talk about is why you're better than the other guy. But still, what happens is you actually increase the use of any product in this class.
So what I'm concerned about is not the intent of the marketing but the effect of the marketing. You seem focused on the intent.
Q. I do. But now I think you've helped me, and your answer is actually the opposite of what I understood it to be before.

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When you say that rivalrous marketing is a noneffect, what you mean is you don't assess whether the marketing was rivalrous or not, because in either case, your view is it will potentially lead to increased MMEs, so it gets counted?
MR. SOBOL: Objection, form, asked and answered.
A. I am interested only in a particular kind of impact, and that impact is an increase in the number of MMEs. If there is marketing that changes the drug people take without affecting their MMEs, then I ignore that.
Let's just say there's unlawful conduct and you earn money off of it, but it's really only because you've switched brands. That, I'm not counting, so that's a kind of rivalrous marketing effect that's not being counted in my impact assessment.
I'm only concerned about market expansion by definition. Economists can be interested in both of those things, but for my purpose, I'm only interested in market expansion.

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BY MR. ROTH:
Q. I'm just trying to understand functionally how that happens.
So the reason you're saying that is because you're only looking at the delta, the change in MMEs, and so if there's no change, then the rivalrous marketing doesn't get counted? I'm just struggling with the mechanics.
A. Sure. Let me try to explain.
If we had two drugs in the market and we looked at their marketing separately, we could ascertain whether your marketing increases your sales, right, and -- and then what we wouldn't know is, is that increase coming from new patients, or is it coming from the decrease in someone else's sales. So we could use a system kind of analysis to show what's happening.
So people have done this in prescription drugs. I know you've spent some time with the literature, and they're curious about when you increase your sales, does it come at someone else's expense or are you just growing the market. And in different

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drug classes, those two things seem to operate differently.

But if you were to add those two drugs together and say, okay, for any herpes treatment, what's the total effect of marketing? Then what you would get is only the market expansion effect. You would wash out any of the market stealing because your gain is my loss. And so those two things would net out and you'd only get the net result. So that's what I'm doing here.

Q. So the mechanics are because it's an aggregate model that's aggregating all contacts and aggregating all scripts, it comes out in the wash if it's rivalrous?

A. Exactly. Rivalrous, again, my definition of rivalrous is my sales come from you and that those two things fully offset.

Q. Okay. But the detail itself is still counted in the model, because you're not actually looking substantively at the detail to determine what happened?

MR. SOBOL: Objection.

A. That is correct. The detail is still in the model, and where the rivalrous

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piece shows up is that it dampens the effectiveness of marketing that we measure.

BY MR. ROTH:

Q. Okay. We're finally on the same page then.

How does your model account for unbranded marketing?

A. Well, in two ways. In Model C, I explicitly put in some of those events. We can look at exactly which ones they are.

Q. I was saving this for later, but we can --

A. I know, it sounds like an after-lunch conversation, but the consensus statement from the American Academy of Pain Management and the American Pain Society, the Federation of State Medical Boards Guidelines, the JCAHO pain standards released.

So these, I understand that plaintiffs intend to prove they were manipulated by the defendants. So I put those explicitly in Model C.

And then as I describe Model B and my rationale and the way I interpret the

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turning points is that they -- that is incorporating these many different events and tactics.

Q. So the unbranded marketing is captured by the way you do the breaks and the way you test for these five events in Model C, correct?

A. That's correct.

Q. But the unbranded marketing is not captured in the detailing contacts you use for your stock of promotion?

A. That's correct.

Q. How does your model account for the peer-to-peer marketing that I think you or Dr. Perri describes as a contagion phenomenon in paragraph 25?

A. Yeah. So that phenomenon will get picked up in marketing effectiveness, because again, we're looking at aggregate prescribing and not just the prescribing of the targeted physicians.

So, you know, as -- we can go back to our favorite paper by Datta and Dave, they're looking at individual physicians.

It could well be, of course,

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detailing physician A causes physician B's prescribing to increase; they're not really looking at that because they're only looking within physician. But we, for the same reasons that I can capture market expansion appropriately, aggregating up across doctors here allows me to capture that contagion effect.

Q. We do agree, though, that at an individual prescriber, individual detail visit level, there could be variation in the impact that visit has?

A. There may be variation in the impact of detailing on an individual prescriber and her network and my model will average that, will generate a result that captures the average.

Q. And we talked a little bit earlier about some of the variability in the way detailing occurs. I think I used the pizza example.

Do you remember that?

A. I remember pizza.

Q. Okay. I want to come back to that for a minute maybe because it's

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lunchtime.
Not every detail visit occurs the same way in terms of time spent and what is disseminated from the pharmaceutical sales representative to the doctor, correct?
MR. SOBOL: Objection, asked and answered.
A. I would not disagree that details can be different day of the week, whether there's food involved, how much time.
BY MR. ROTH:
Q. And frankly, who is detailed, because it could be a prescribing doctor or it could be a nurse practitioner, it could be some other healthcare professional in the doctor's office, right?
A. Yes, that's correct.
Q. And does the IQVIA data you've looked at distinguish between the target of the detail?
A. It distinguishes between office-based and hospital-based physicians, but it does not distinguish by licensure as you've just described.
And again, what I'm interested

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in is the aggregate impact, and therefore, the average across that variation is appropriately subsumed in my analysis.
Q. Right. And because you used the average, whether the sales rep makes contact with the prescribing doctor and spends 15 minutes discussing the virtues of opioids or whether the sales rep quickly speaks to a nurse practitioner to leave the coffee mug will get treated the same as an average in your model?
A. Yes. And that is appropriate if you're interested in the aggregate effect. If I were interested in comparing the difference between a detail with pizza versus a detail without pizza, then I would want to look at them. But I'm only interested in the aggregate effect.
Q. Are you aware that detailing could be limited to simply providing literature that contains information contained in the package insert or approved by the FDA in promotional materials?
MR. SOBOL: Objection.
A. I'm not exactly sure what you

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mean by simply. I think we're getting into a question about what and how will be proven to be unlawful. And if the question is was certain information omitted, then the fact that the information that was provided was in some way not challenged, to me, seems like it could still be a problem.
But the larger issue is that I think it's not appropriate to try to pull these detail visits off one at a time. If there was some messaging around the utility of treating patients with opioids at an earlier visit and these later visits are just reminder visits, again, I'm not -- I'm not trying to prove liability here, but to me as an economist, it seems like they could well be connected.
BY MR. ROTH:
Q. And they all count the same way as the average?
A. All -- all details in my data are included in the right-hand side, and they produce an average effect, and then I back out those particular ones deemed unlawful.
Q. And similarly, if the detail is

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corrective messaging designed to dampen the effects of some prior materials that FDA has issued a warning letter on, those detail visits get picked up by your data as well?
MR. SOBOL: Objection.
A. I think you need to understand what the regression is doing. It is not just saying sales are strictly promotional to detailing. It's trying to look at that effect, and, in fact, in the last period of my three-period model, the effective promotion is declining.
To the extent that there's corrective messaging, that may be one of the factors that is decreasing the effectiveness of promotion, and so there are not MMEs assigned to have been produced by that detail.
BY MR. ROTH:
Q. Let me just ask a simpler question: Yes or no, are details that are simply designed to provide corrective messaging included in your stock of promotion?
MR. SOBOL: Objection, asked

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and answered.
A. I really have no idea about whether such details exist. My model includes all detailing over the period from 1995 to 2018 based on the instruction that I was given to consider that unlawful.
BY MR. ROTH:
Q. Okay. Without distinguishing between the quality or extent of those detailing visits?
MR. SOBOL: Objection, asked and answered.
A. I do not distinguish among those details, no.
BY MR. ROTH:
Q. And I think we talked about this, but I'm not sure.
You don't differentiate between which physician practice groups were targeted by the details in your model?
MR. SOBOL: Objection, asked and answered.
A. As I noted, my detailing measure is national. It's aggregate. It does not distinguish at a level below that.

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BY MR. ROTH:
Q. Do you have any view as to whether allegedly deceptive marketing is more impactful than truthful marketing?
A. I think I do discuss this in my report, and there's an economic theory related to the profitability of fraud and some evidence from other sectors that suggest that for something unlawful to be undertaken when lawful activities are possible, that it must be more profitable because there's some cost associated with matters such as this one. And so that would suggest that that kind of marketing must be more profitable than marketing to other physicians.
I think this is -- it depends on what assumptions we're making about the intention and knowledge of the various actors. So I think it could go either way.
Q. But within your model, within the time periods of your model, you treat each of the details equally because in your view, you assume them all to be equally unlawful at this point in time?
MR. SOBOL: Objection.

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A. I am, as we've noted earlier, operating on the assumption that the defendants' conduct during the relevant period was unlawful, and my model uses a single measure of detailing and therefore averages across allegedly lawful and unlawful details.
BY MR. ROTH:
Q. Let's look back at Datta and Dave because you asked to.
A. Okay.
Q. It's Exhibit 5, for the record, and I -- can you turn with me to page 454.
A. Okay.
Q. So at the top of the page it says: Thus, detailing plays a role in educating providers about newer drugs and their attributes and may have information value early in a product's life cycle, whereas later in the life cycle, its role can be predominantly persuasive and chiefly relegated to delivering samples and reminders.
Do you see that?
A. I do.

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Q. And then at the end of the paragraph, they say: Because detailing can affect both selective (brand centric) and primary (market) demand under these views -- citation to Dave and Kelly, 2014 -- the question cannot be resolved based on theory alone, and empirical evidence needs to bear upon the question.
Do you see that?
A. Yes. Just to be clear, what they're talking about there is the welfare effects of marketing, and that is a separate question than the one that we're discussing here.
Q. It's the same issue that we've been going around on, right? You're not looking at the welfare, you're not looking at the quality; you're just looking to see if there's a correlation between detailing visits as a stock of promotion against MMEs --
MR. SOBOL: Objection, asked and answered.
BY MR. ROTH:
Q. -- on an aggregate basis.

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rate is about here.
BY MR. ROTH:
Q. So is your suggestion that the doctors are addicted to writing prescriptions?
MR. SOBOL: Objection.
A. I didn't say that.
BY MR. ROTH:
Q. So when you say it's the addictiveness, your suggestion is because the patient may become addicted, the doctor is going to continually ratchet up the dosage for that patient?
MR. SOBOL: Objection.
A. You make it sound like the opioid epidemic is speculative. It is clearly true that patients who started on a particular dose of opioids get higher and higher doses. That has -- that is just common knowledge, and other experts have opined on that.
And so it is a fact of the matter that some patients will require escalating values in terms of the number of MMEs, whether they're addicted or not, and

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then also it is true that some of those patients will become addicted. I think there's no question in the literature about whether prescribed opioids cause addiction. So that is true.
And the fact of the matter is that I'm not describing physician behavior as addictive; but if those patients come back to their physician and say, "My pain is getting worse, I need another prescription," then in some instances it will be filled.
BY MR. ROTH:
Q. What percentage of patients need escalating doses of opioids?
MR. SOBOL: Objection, scope.
A. I'm not a clinical expert. My analysis is entirely empirical. If this were not happening, my analysis would not find that these MMEs are inflating over time in the way they are.
BY MR. ROTH:
Q. I know you're not a doctor, so I'm just trying to understand, like what -- you say it's common knowledge.
What basis in science or

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literature do you have to opine that the addictiveness of opioids means that doctors are prescribing higher and higher dosages to their patients?
MR. SOBOL: Objection, asked and answered.
A. If you look at Figure 3, this is where I empirically demonstrate what's happening with the strength --
MR. SOBOL: Page?
THE WITNESS: Oh, sorry.
Page 37.
BY MR. ROTH:
Q. Right. That's on an aggregate basis. I asked you a different question. With --
A. No, no, no. I'm sorry, but the aggregate basis means that the average MMEs per prescription is escalating at this very high rate. That means that some large number of patients under it -- for it to increase at this rate, it cannot be that just a handful of patients are getting more.
Q. It could just be, though, that stronger drugs are prescribed. It doesn't

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mean that a specific patient is getting higher and higher doses because of the addictiveness of opioids.
MR. SOBOL: Objection.
A. I do not derive that -- these data really show that higher and higher doses of MM- -- of opioids are being prescribed. I mean, that's just literally what they show. The MMEs per prescription is increasing.
So that is showing that -- whether it's addiction or not, that patients are getting higher and higher doses. That mechanically will have the effect of making it look like past promotion is suddenly more effective today than it was yesterday.
BY MR. ROTH:
Q. And so, in effect, your depreciation rate is an appreciation rate in your model.
MR. SOBOL: Objection.
A. You may use that term. I think it's more standard to call it a depreciation rate. Also, as you know, I estimate multiple models, and they don't all have a negative depreciation rate.

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BY MR. ROTH:
Q. What do your models say about a single detailing visit in January 1995 with regard to its impact today?
MR. SOBOL: Objection.
A. Can you explain what you mean by that?
BY MR. ROTH:
Q. Yeah.
So the way your stock of promotion is calculated, it keeps aggregating. So would a visit in January 1995 still be growing in impact in your model?
A. In the fact -- in the models with the negative depreciation rates, the past promotion continues to grow, yes.
Q. And at what point does it reach its maximum impact?
A. Well, I think you should not try to extend the analysis out of sample. Again, what I show in my model is while on average, because I estimate a single negative depreciation rate, we see this negative depreciation rate, but we also find that the

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effectiveness of promotion is falling.
And so while the stock may be increasing, its effectiveness is decreasing.
Q. Yeah, and we'll get to the other adjustments. I just want to talk about the depreciation rate first.
So under your model, the detailing that happens today is 8.3% more impactful next year than it is today?
MR. SOBOL: Objection.
Objection.
A. For a given quarter, after a year, the appreciation is 8.3%, yes.
BY MR. ROTH:
Q. And after ten years, detailing that happens today would be 223% more impactful than it was today?
A. I think you'd have to give me a calculator, but I'm willing to trust your math.
And just to be clear, it's not exactly impactful because, again, you have to recognize that the coefficient on promotion is changing over this same period, and because that -- that coefficient is dropping,

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we're actually seeing reductions in sales.
Q. You agree that an appreciating depreciation rate is at odds with the usual marketing literature in economics?
MR. SOBOL: Objection.
A. I don't know that it's at odds with the underlying theory of marketing. Because this is an addictive good, I think it's a very different set of circumstances.
Usually we do see depreciation falling, but I would note also that this is a special case, as we've talked about many times today. I'm interested in this entire market and not one drug.
And so usually when the marketing literature is looking at this, they're looking at an individual drug, maybe even an individual physician. And here we're really talking about the growth of an entire set of practices around the use of opioids.
BY MR. ROTH:
Q. You say in your report: A negative depreciation rate indicates that the stock of promotion grows over time.
Correct?

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A. Yes.
Q. And then you say: This prediction may be at odds with the usual marketing literature.
A. Yes. But I want it to be clear, however, that it's not a theoretical, the theory that I've just described, whereby the role of addiction is entirely consistent with a negative depreciation rate.
Q. And in your report, where you say that, you've got a footnote and you cite to Perri's report?
A. Yes.
Q. And you quote him in saying: Additionally, because prescription opioids may result in tolerance, dependence, and/or addiction, the overall demand for opioids is distorted by pharmaceutical marketing aimed at increasing the use of these drugs. I refer to this as a distortion because, whether due to tolerance, dependence, or addiction, some patients who use opioids require and/or seek more opioids over time.
Did I read that correctly?
A. You know, I thought I saw that

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correct footnote, and then I was looking at the wrong one.
Q. Sorry. It's page 49, 103.
A. 49.
Yes.
Q. And based on that statement, you believe that a negative depreciation rate, although at odds with the usual marketing literature, is perfectly consistent in this case?
A. Just to be clear, I'm not relying on Dr. Perri for my understanding that opioids are addictive. I'm relying on the broad facts of this case, my knowledge in public health, and that is the reason why I think, while marketing studies that have looked at other goods have not found this, it is entirely theoretically consistent that we would find a negative depreciation rate here.
Q. Have you looked at marketing studies relating to other addictive goods?
A. I don't know of any other marketing studies related to addictive goods.
Q. Tobacco?
A. Yes, I have -- I'm certainly

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familiar with the tobacco literature. That literature, as you may know, focuses largely on taxes and the effect of a marketing ban in terms of broadcast advertising.
I don't know that the literature has looked at the stock of promotion at all.
Q. What about marketing literature related to alcohol?
A. I have not seen any of that literature, no.
Q. What about marketing literature related to marijuana?
A. I --
MR. SOBOL: Wait. Is that addictive?
THE WITNESS: Wait, is there marketing? But now, you're right, there may be a market.
I would be interested to know if such literature exists. I'm not familiar with any literature like that.
BY MR. ROTH:
Q. Okay. As you sit here right

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now, do you know of any literature, whether related to nonaddictive or addictive products, that has a negative depreciation rate?
A. I cannot point to any other study, no.
Q. Let's look at the Datta and Dave study again. So if you look at page --
A. Sorry, I lost Datta and Dave.
Q. Sorry, it's okay.
A. Yeah. Okay. I got it.
Q. Page 457, footnote 23.
Do you see that?
A. Yes.
Q. So in this study, it says: We chose to rely on the literature for fixed estimates of the depreciation rate rather than estimate it as an unknown parameter.
A. Yes.
Q. And they say: An unbiased estimate of the depreciation rate would require a detailed structural modeling of promotion and prescription behaviors, without which it would be difficult to disentangle the coefficient of the detailing stock from

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the depreciation rate.
And there's then a cite to Iizuka and Jin.
Do you see that?
A. I do.
Q. And in what way did you structurally model prescription behaviors in your model?
A. Well, I followed the same practice that Professor Berndt and others have used, which in effect simultaneously estimates the two parameters. It's not, strictly speaking, a structural model. It really requires that we reestimate the model with a whole range of estimates and then see which one has the best fit. It's an alternative approach to the structural modeling approach.
Q. Datta and Dave go on to say: Prior research on consumer behavior suggests that advertising effects fully depreciate within six months to a year, consistent with decay rates of 0.1 to 0.2, which have also been found to apply to pharmaceutical advertising.

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Do you see that?
A. I do.
Q. Okay. And then --
A. I would note that Professor Berndt's article that you shared with me earlier finds a depreciation rate of zero, and he concludes there and elsewhere that it's consistent with our understanding that pharmaceutical marketing is long-lived because of the habit formation, so there's clearly some disagreement in the literature about what's the right answer.
Q. Right. But he has no depreciation rate. He doesn't have an appreciation rate in his study.
A. The difference between zero and a small negative is -- they're both kind of getting at the same notion, which is that marketing from many periods ago is still persistent today.
Q. And the Berndt study you're citing predated this Datta and Dave study; is that right?
A. I believe it did, yes. It's an earlier study.

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(Whereupon, Deposition Exhibit Rosenthal-9, 2004 Mizik and Jacobson Publication, was marked for identification.)
BY MR. ROTH:
Q. Okay. And now I'm going to show you Exhibit 9, which is the Mizik and Jacobson study, Are Physicians "Easy Marks"? Quantifying the Effects of Detailing and Sampling on New Prescriptions.
Do you have Exhibit 9 in front of you?
A. I do.
Q. And this is another document you relied on and quoted in your report.
A. Yes.
Q. And if you look at page 1710, under the chart, do you see there's a heading Detailing?
A. Under -- in Table 2?
Q. Yes. There's a Detailing heading on the column underneath Table 2.
A. I'm sorry.
Q. Sorry, I'm below Table 2. Left side.

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A. Oh, yes. In the text.
Q. In the text.
A. I'm sorry, I was looking in the table for a column heading. Yes. Yes. I'm sorry.
Q. Okay. So in the column heading in the text, it says Detailing, and then it says: For each of the three drugs in the study, we observed statistically significant positive albeit modest effects of detailing on prescriptions.
Do you see that?
A. Yes.
Q. And then it says: Both current term and carryover effects exist. For drug A, statistically significant positive effects are present contemporaneously and for the subsequent four months.
Do you see that?
A. Yes.
Q. And then if you jump to the next column, the bottom paragraph says: The estimated response to a change in PSR visits for drug B is similar to drug A in that we observe a statistically significant response

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the month of the visit that diminishes over the subsequent six months.
Do you see that?
A. Yes.
Q. And then you referred already to the Berndt study, which I believe you have there.
A. Yes.
Q. If we look at that at page 104 -- it's Exhibit 8 -- I thought you said the depreciation rate was zero, but looking at page 104 on the second column, it actually looks like it's 0.03.
A. It may be there's another Berndt paper that I believe that I cite. I know there's a zero depreciation rate in one of them. That may be -- if we look at my literature summary, it may be clearer.
Q. Okay. We can do that on the next break, but for now let me just mark Exhibit 10.
A. Okay.
(Whereupon, Deposition Exhibit Rosenthal-10, 2001 G?n?l et al Publication, was marked for

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identification.)
BY MR. ROTH:
Q. Which is the G?n?l study, Promotion of Prescription Drugs and Its Impact on Physicians' Choice and Behavior.
A. I'm sorry, were you going to ask me a question about this study?
MR. SOBOL: Which one?
BY MR. ROTH:
Q. I think I did. I was just asking what the depreciation rate was and you said --
A. I'd just like to remind you, when we talk about these marketing studies, and Mizik and Jacobson is similar to the Datta and Dave one, it's a short period of time for a few select drugs. It doesn't have the ability to look over the long term the way we do.
Q. No, I understand.
And for those drugs, the depreciation happened within months. In your model, the appreciation happens forever.
A. Yes.
Q. So if we look at Exhibit 10,

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the G?n?l study, if you look at page 85, there's a paragraph, Cumulative Discounted Sums of Detailing and Samples.
Do you see that?
A. You're on 85?
Q. 85.
A. Yes.
Q. And in that paragraph it says: For each prescription physicians write, they are likely to be influenced by past personal selling efforts. We discount the cumulative personal selling effort consistently with the methods used in the advertising literature. The major premise of these methods is that physicians are influenced by the recent visits of sales representatives more than by the distant ones.
Do you see that?
A. I do.
Q. And it looks like in this study -- well, maybe you can help me find it. I don't know if it's on this page.
A. They don't -- they don't estimate a depreciation rate. It says they set one.

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Q. Got it.
A. I think it must be in the footnote. Yes.
Q. Yeah. I don't see the exact number. But in any event, they depreciated their stock somehow, and if we took the time to review this, we could probably find the exact number.
So switching gears for a second. So you said you're not aware of any article. Have you ever done any work in your litigation consulting or expert practice where you've modeled a negative depreciation rate before this case?
MR. SOBOL: Objection, asked and answered.
A. I would return to the fact that this matter concerns a class of drugs that is different from any other class of drugs for which I have looked at marketing, and I believe that the negative depreciation rate is entirely consistent with that underlying phenomenon.
I have not worked on opiate addiction in the past. I have not worked on

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a marketing study for an addictive product.
BY MR. ROTH:
Q. Okay. And as you sit here now, you're not aware of any peer-reviewed publication or study that suggests that a negative depreciation rate is ever appropriate?
MR. SOBOL: Objection, asked and answered.
A. It's my belief that a negative depreciation rate is entirely theoretically consistent with this product. I cannot cite a paper that has estimated one, but I do not find it surprising.
BY MR. ROTH:
Q. Okay. Let's look at paragraph 55 of your report and Figure 4 below that. Are you there?
A. I'm sorry, you're at paragraph 55 -- I'm sorry, I went to the next page.
Q. Yeah, and it spills -- sorry, it spills to the next page, which is Figure 4.
A. Yes.

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Q. Are you there?
A. Uh-huh.
Q. And in this chart it looks like you actually model your depreciation rate in red against what your model would look like with no depreciation rate or even a small positive depreciation rate.
A. I show you what that would look like, yes.
Q. So with even a very slight positive depreciation rate, the line looks almost flat.
A. You mean the .01?
Q. Correct.
A. Yes.
Q. And if you hold the depreciation rate at zero, it's got a small increase, but not anywhere close to what you show with your negative depreciation rate?
MR. SOBOL: Objection.
A. But as you've described the lines, the line that represents the depreciation rate I estimated grows more rapidly, as would be expected because of compounding.

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Just to be clear, the fact that the stock of promotion grows in this pattern, that is a question of fitting the model appropriately. It's not driving my results in that same relationship.
BY MR. ROTH:
Q. I'm not sure I understood your last answer. What do you mean it's not driving your results?
A. Well, the results aren't inflated in the same way that the stock of promotion is inflated. The estimate in my model, again, where I have promotional effectiveness coefficients, they're now responding -- they'll be lower than otherwise because the average level of promotion is higher, and so it effectively makes promotion look less effective on an incremental basis.
And this is really a question of just getting the best fit in terms of the timing.
Q. Okay. The blue line on this line graph you describe as the flow of the data. Can you explain what that means?
A. Sure. Those are the monthly

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levels of contacts.
Q. So with no adjustment for a stock, this is just the ebb and flow of where the IQVIA data shows promotion is?
A. Yes, it's the unadjusted IQVIA total detailing contacts.
Q. So it spikes up and down over the course of the entire period?
A. It does have the pattern that you see there.
Q. Okay. Have you run your models with positive depreciation rates other than the 0.01 you depict on Figure 4?
MR. SOBOL: Objection.
A. That's not running the model. That's just showing you what the stock would look like.
BY MR. ROTH:
Q. Okay. So have you even run the model with the stock at 0.01?
A. I have not.
Q. Okay. So you don't know what that would look like, and you don't know what it would look like if we used a higher depreciation rate?

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MR. SOBOL: Objection.
A. I don't.
BY MR. ROTH:
Q. And I think you said this, but your model selects the depreciation rate that produces the best fit?
A. Yes, that's correct. It uses a Wald test.
Q. Okay. We'll come back to the Wald test. But let's look at Figure 2, which, I believe, is a few pages earlier.
A. Page 36?
Q. You got it. So Figure 2 is a line graph of the MMEs over time.
A. That's correct, and it also includes extended units in blue.
Q. And what does that mean, "extended units"?
A. Extended units are pills.
Q. Okay. So you've got both the pills and the MMEs on this graph?
A. Yes, and you can see they track almost perfectly.
Q. And you can tell, I think, the first thing I see when I look at this graph

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is a pretty stark decline that starts in 2010.

Do you see that?

A. It does have a clear peak, both of those trends.

Q. And do you have any understanding as to why MMEs began to drop off starting in 2010?

A. Well, I think I write about that pretty extensively in my report.

Q. In paragraph 46 -- yeah, let's look at paragraph 46.

A. Maybe not 46. Maybe 56?

Q. Oh, you know what, that's Gruber 46. We'll get to him next.

A. I'm sorry. Okay.

Q. Sorry, which paragraph were you taking me to?

A. I am looking for where I discuss the peak.

Q. All of your reports magically have the same font and type space, so it's hard to differentiate.

A. I think it's later when I talk about --

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Q. 67 --

A. -- estimating the breaks.

Q. 67.

A. Yeah?

Q. Yeah. I think I found it.

A. Yes.

Q. Okay.

A. So that's sort of the -- that's where I talk about the first break.

Q. Yeah. So you say: The accelerated growth in opioid prescribing that followed the guideline and messaging changes continued for approximately a decade before it was finally arrested and ultimately reversed by the cumulative effects of physician leadership, media attention, public health surveillance and regulation.

Do you see that?

A. I do.

Q. And you agree that all of those efforts, doctors, media and public health, did not just simultaneously happen in August 2010?

A. They did not, which is why I don't assume that.

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Q. And when you refer to regulation in that paragraph, what specifically are you talking about?

A. Well, so, for example, certain states required that physicians use a database to look at prescribing for the patient before they could write a prescription, so prescription drug monitoring programs and educational requirements around those prescription drug monitoring programs.

In some places there are -- like Massachusetts, for example, there have also been prescribing limits that were passed. So those kinds of things.

Q. And then did you review Professor Gruber's report?

A. I did.

Q. Before yours was finalized or at some point after?

A. Perhaps before.

Q. Okay. So I'll -- I could mark it, but I'm just going to read to you from it. And if you want me to mark it, I will.

But he says in paragraph 46: Beginning around 2010, increased enforcement

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actions by DEA and DOJ, criminal actions and litigation, the growth of state PDMP laws and increased awareness of addiction risks associated with prescription opioids contributed to a reduction in aggregate shipments of prescription opioids after more than 20 years of rapid growth.

Are you aware of that passage in his report?

A. Yes, and I think that there's absolutely nothing inconsistent with what he says. He uses a couple of different examples, but we're in agreement that it's multifactorial and gradual.

Q. Agree. And you both mention PDMP laws, and I think he's got a couple of other examples about the DEA and DOJ.

But that was what I was going to ask you is, are you in agreement with him that these multifactorial events contributed to the decline in 2010?

A. That is the environment that I capture using that third era in which these events are essentially reducing the effectiveness of promotion.

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Q. Okay. So let's talk about your eras. So if you go to paragraph 71, you're talking about Model B, and I think you called this in your report your preferred model.
A. I do.
Q. Okay. And just so we differentiate, we'll get to Model C.
Model A, as you describe it in paragraph 70, is assuming the effectiveness of detailing is constant, so meaning, if I look at Table 1, you just used the stock of promotion and the depreciation rate without adjusting for different eras in Model A.
A. Yes, that's correct. I mean, they both have a single depreciation rate, but there's a single stock of promotion in Model A, and the price index, of course.
Q. And then in Model B, it's those two things plus you've added these two eras in?
A. That's correct.
Q. And in Model C, it's Model B with the five events mapped onto it?
A. That's correct.
Q. Okay. So let's start with

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Model B. 71 says: Model B allows the effectiveness of promotion to change at two points in time, determined using specification tests. Thus, this model captures three different periods or eras of the opioid market: the initial era, an increase in MME sales during the second era, and a third era marking the gradual decline of MME sales.
Do you see that?
A. Yes.
Q. What do you mean, "determined using specification tests"?
A. Well, we essentially -- we do much the same as what Professor Cutler does in his report, which is basically conduct an F-test, which is looking at the fit of alternative models, and we have these -- we have two time points, so we're looking at a two-dimensional space and looking to see which model fits the data best by, again, iterating over -- I think it says in --
Q. Yeah, let's look at Attachment D5. I'll help you out.
A. That's right, iterating over, I

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don't know, 1600 models, something like that.
Q. You get how this goes. I get your memory first, and then we can look at the report.
A. Yes. I know I should just tell you that I don't remember.
Q. That's okay. All right. D5, Determining Turning Points in Effectiveness of Promotion.
A. Okay.
Q. Tell me when you're there.
A. D5. Okay. Yes.
Q. So it says: In Model B, the two dates that would delineate the early and late change in the effectiveness of promotional stock were determined through a two-dimension search. The first turning point was chosen between January 1999 and January 2003, and the second turning point was chosen with the date between January 2010 to December 2011.
Do you see that?
A. Yes.
Q. So let me stop there.
So when you say "it was

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determined between," were you just conducting the searches within those date ranges?
A. Yes, that's right.
Q. So you didn't just search the whole model for the breaks; you limited the dimensions you were looking for?
A. Well, as you can see, there were 1,176 combinations already, so there's a bit of a scale issue in looking at every combination.
And also, the way the tests work out, it seemed fairly clear that we weren't getting better and better fit by going out further, that the solutions were closer to the middle, and so that's why we didn't feel like we needed to go outside of those ranges.
Q. How long did it take the computer to run 1,176 combinations?
A. Fortunately, I did not have to run those myself. Probably not that long.
Q. I feel bad for Greylock.
And so you ultimately chose these two breaks based on the maximum Wald statistic produced from running the model

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almost 11 -- 1,176 times?
A. That's correct.
Q. And what is a Wald statistic?
A. It's -- like I said, it's like an F-test that's looking at the joint significance. We talk about an F-test elsewhere in this model, looking at the joint significance -- actually, in my errata you see I talk about the F-test, doing significance of a set of variables and seeing the formulation in which those variables explain -- effectively explain the model best.
Q. And is it a common practice in econometrics to choose a model based on maximum fit?
A. It's one of the considerations that one does in a model. And here we're talking about a set of parameters that we're trying to optimize with regard to depreciation. It's not the only thing that we use to select the model.
As you know, I also report the adjusted R-squared, and that was part of my decision-making across models. And there are

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other factors.
Q. Okay. If we turn back to the body of the report, paragraph 57 introduces Figure 5.
Do you see that?
A. Uh-huh.
Q. So you say: Figure 5 -- which is on the next page -- is a timeline of key events. According to plaintiffs' experts and the published literature, the perceptions of physicians and the public evolved as a direct result of the alleged misconduct.
Do you see that?
A. Yes.
Q. You cite Dr. Perri.
A. Yes.
Q. And then you say: These changes, which were the result of the defendants' actions, would have affected the receptiveness of prescribers and patients to promotional messages about the safety and effectiveness of opioids.
Do you see that?
A. Yes.
Q. And then you describe how the

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key events identified by plaintiffs that helped promote expanded prescribing are in green and the subsequent public health and regulatory events that signaled the growing realization about the dangers are in red.
A. Yes.
Q. All right. So let's look at Figure 5 on page 41, and we're going to do our best job to articulate on the deposition transcript the picture that we're looking at.
So it looks to me like Figure 5 is --
MR. SOBOL: Why don't you show it to the camera for a second. Seriously. Just get a shot of that.
MR. ROTH: It's a work of art.
THE WITNESS: It is a work of art.
MR. SOBOL: Christmas.
BY MR. ROTH:
Q. So if you look at Figure 5, you've got the MME trend graph that we looked at in Figure 4 with a timeline and the events described in the paragraph above it, right?
A. That's correct.

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Q. And so we'll talk about the five you picked to test in Model C, but did you think about using any of the events on this timeline to choose where you do your testing for the breaks?
A. I considered and rejected that idea for reasons I think I do describe in my report. And I'm happy to explain further.
Q. Yeah, if you don't mind.
A. So as you can see from the timeline, there are a number of discrete events. They're marked on the timeline at the time they were either announced or passed or in some way published, and still, they are clearly events that could have had both anticipation effects and sort of long adoption curves.
And so just the notion that these -- any one of these points would have determined a break in the promotional effectiveness, it seems like it was not quite the right model. Although, again, I included them in Model C to explore this further.
It's my opinion that these should be treated more cumulatively and that

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is why I used the multi-era model, and I think that's entirely consistent with the way Dr. Perri describes the events, particularly the green ones, the ones that were influencing the adoption of opioids.

Q. Just so I understand it, your break based on the Wald statistic is sometime in early 2002; is that right?

A. It's probably not a good idea ever for me to trust my memory, so I'm going to go and look at that.

Q. Yeah. It's in the report.

A. Yes, it is, it's absolutely in the report.

Q. And it may be in the errata, because I saw some of the dates changed a little bit last night.

A. Paragraph 71.

Q. Paragraph 71, yeah.

A. Right. So March 2002 is the first break.

Q. In the report it says April 2002. That was one of the errata?

A. Yes. I think someone was reading the first month versus the last

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month, the first of the old era versus the last of the -- first of the new era.

Q. So it changes as of April 1st?

A. It changes as of March 1st. I mean, the data are monthly, so -- not daily, so it changes as of March.

Q. Okay.

A. And then the second turning point changes as of August.

Q. So if we were to plot March 2002 on Figure 5, it would be after the first five events in green but before the last two events in green?

A. That -- I can affirm that.

Q. And then if we were to plot the August 2010 break on the curve in Figure 5, it would be -- it looks like after maybe three or four of the red events but before the other six or seven.

A. I -- that may be true. I think it's a lot harder to say. That's just a dense part of the chart, and I wouldn't trust my eyeballs on it.

Q. Okay. But again, as we discussed, those breaks are not correlated

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with these events; they're the function of searching using the Wald statistic for where the curve breaks?

A. Yes. And again, to be clear, they're telling us where the relationship between the stock of detailing and sales seems to change in a statistically significant way. And they're entirely consistent with some kind of S-curve at the beginning, when we think about a standard diffusion curve, that there -- there is sort of a point at which diffusion accelerates, and that is what we're estimating on the first one.

And the second turning point I guess would be a reverse diffusion curve. I think de-innovation is a word, and not one that I use a lot, but that seems to be what's happening. And again, it's not like you've turned on a light switch and everyone changes, but cumulatively over time, that's putting the brakes on.

Q. Okay. But your model, the way you account for that is you do actually turn on the light switch and change the stock of

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promotion as of those dates?

A. I -- no. That's not -- that's not true. So what I do is I allow for the promotional effectiveness to change in the -- in the first instance as a level shift and in the second instance as a trend shift.

Q. And so we'll talk about each of those, but in paragraph 68 you talk about how this led you to adopt a piecewise model. What is a piecewise model?

A. Well, it's essentially where I assume there's a linear relationship between the stock of promotion and sales that differs over these different eras.

Q. And when is it appropriate to use a piecewise model in econometrics?

A. Well, in this case, this is an aggregate time series model, and we believe that the fundamentals of that relationship are changed by something in the environment.

Q. So in addition to your appreciating depreciation rate, we now have adjustments in these two eras to fit the MME curve.

MR. SOBOL: Objection to form.

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A. Just to be clear, it's about fitting -- the R-squared is about fitting the MME curve, but really, the test that we're doing is about understanding the relationship between detailing and sales and fitting that.
BY MR. ROTH:
Q. I understand that, but you're making modifications to the detailing stock that is allowing it to fit better with the MME curve?
A. Well, the detailing stock and -- you're talking about the depreciation rate. That is being determined, again, based on the fit of the overall statistical model. It's not just trying to make it fit the shape of the MMEs, which I think is what you said.
Q. Right. But when you make the depreciation rate change to the stock of promotion and then you allow the model to tell you where the effectiveness of promotion also changes, are you not then essentially fitting the detailing curve to the MME curve?
A. I do not believe so, no. That's not what I'm doing. What I'm trying to do is establish a relationship that best

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fits the data. Over time, that relationship could be that promotion has very little effect on sales. And so the quantum of the impact here is not what I'm fitting the data to.
Q. Okay. As you describe it in your report, the coefficients on the stock of detailing are estimated separately during each of the three eras; is that correct?
A. Well, in effect, we can look at the results, so maybe it will be a little clearer than my hand-waving without having it in front of me.
Q. Table 1, is that what you wanted or do you want --
A. Yes, Table 1, that's right. So we have the stock of promotion through --
MR. SOBOL: I'm sorry, page?
THE WITNESS: Oh, sorry.
Page 47. Sorry.
A. We have the stock of promotion that is the continuous series that we saw plotted in that other figure, and then in Model C, I interact that with the dummy variable for the first era.

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And then I also -- I interact that separately with the variable from March 2002. So those two are essentially separate estimates over those two time periods, but in -- in the third period, because we're looking at an erosion curve, that's just literally what's happening here is opioid prescribing is eroding. I enter the interaction with that era as a trend, so then that's the sum of the stock of promotion from 2002 and the dummy trend.
BY MR. ROTH:
Q. All right. So you're jumping ahead of me. I'm going to ask you about the dummy trend.
A. Okay.
Q. But the stock in period 3 is actually overlapping with the stock in period 2; is that right?
A. Yes, the stock of promotion -- again, because the third period basically is adding on to the second period, they're being estimated -- I mean, the model of course is estimating over the entire period, but the variables are separated such that we have one

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variable that's the stock of promotion times a dummy variable, so it becomes zero at March of 2002. That's beta-1.
And then beta-2 goes a variable that's zero before 2000- -- that break date -- now I can't remember if March is the -- oh, yeah, it is March of 2002, so Table 1 was always right -- up to 2002, and then it becomes whatever the stock of promotion is, right?
And so beta-3 has that same stock of promotion and it has this multiplier effect for the trend.
Q. So what I'm trying to understand is before you put in your trend into period 3, if we recognize that there's a period, according to you, of rapid growth after efforts to market --
A. Yes.
Q. -- followed by a period of decline after growing realization about the dangers, why are those starting from the same baseline and adding a trend as opposed to having some other variable applied to the stock in Era 3?

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A. Yeah, let me try to explain that. And just to be clear, I know you know this, but let me just remind you that the turning point in the MME trend is not the turning point that marks off Era 3, right?
Q. Right.
A. That starts earlier.
One thing one could have done is just say, okay, we're going to split the model at that turning point, and so that is the light switch notion, rather than looking to see where the relationship seems to change.
And we know the relationship is such that it's -- we know conceptually, based on the other evidence, that -- and just from reading the news, that public health authorities are trying to limit opioid prescriptions and they're having some success, and so that we know that we need to put in a trend that will capture when that happens.
There's no way to have something that is an increasing trend go south without giving it the opportunity to

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have a second coefficient. And by using a trend and allowing the break to happen whenever it happens, I can actually allow the data to tell me at what pace that erosion happened.
Otherwise, I would have to sort of, again, plug it at the top and just measure the relationship on that second bar. So this was the most flexible way to use the data to look at what's happening to promotion over time. It's entirely flexible. If, in fact, you know, promotion kept going up and it was just not explaining that trend, then the model would have told me that.
Q. Okay. So now I want to get to the dummy trend.
A. Yeah.
Q. So what support do you have for using the dummy trend only in Era 3 as opposed to before?
A. Yeah, for sure. So again, because in Era 2 what we're looking at was a growing acceptance of the idea that opioids were safe, that we could have used a trend there.

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A linear shift is the simplest way of capturing that, and essentially, what will happen is then in that case, by using a shift rather than a trend, what we'll get is an average effect as opposed to one that -- where we can plot out the changes over time, if there were changes over time, but it would capture that increase either way.
When we're looking at the erosion side, however, just picking -- putting an additive effect in like the first trend, would require that we fix that really to the peak of the model in order to make any sense of -- of the way the trend reverses, and yet again, we don't -- we don't change the underlying stock of promotion. That is what it is.
If, in fact, that relationship can't be explained by the stock of promotion, then we would -- we would not get a significant coefficient on that.
Q. When you implement the dummy trend incremented by month in the third era, that means the effect of the third period stock is increasing over time still, right?

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A. Well, the effect of the stock is what it is with the negative depreciation rate. So the effect -- the stock continues to increase, as we discussed earlier, and nonetheless, the productivity of a given unit is decreasing. So relative to the previous period, the average productivity of a unit of the stock of promotion is lower.
Q. Did you try to run the model using a dummy incremented by months in the first two eras?
A. I don't believe so. Again, the simplest -- the simplest way to think about that was a slope change, and that's what we did there. It was really only when we came to trying to figure out how best to let the data tell us about this turning point that a trend seemed like the best approach.
Q. If the effectiveness of promotion is changing in each of the eras, why did you keep the depreciation rate constant the whole time?
A. We used a single depreciation rate because we think that it is something more structural. As I've talked about, the

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discrete events, all of which are picking up on broader phenomena, either a loosening of restrictions around opioids or a tightening of restrictions, and just conceptually, trying to pin any one of them to have begun at a discrete point in time seems problematic; and likely, the reason that I get a counterintuitive result is that there are other correlated -- for example, putting both the OxyContin reformulation and the hydrocodone rescheduling may have caused some interaction between the two.

And so that's also why I didn't then just try to keep adding events with the notion that this was not the right modeling approach for what was going on in this market.

Q. Okay. And then if you look back at Table 1, you mention the OxyContin reformulation, which does not look like it was statistically significant, but also resulted in estimating [redacted] additional MMEs?

A. That's correct. It's zero, but positive.

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Q. Are you aware that Professors Cutler and Gruber opined that the 2010 OxyContin reformulation led to an abrupt market shift that thickened the market for illicit heroin?

MR. SOBOL: Objection to the form.

A. I am aware of their general opinions. I could not have quoted them. But I'm aware that it's more broadly understood that the reformulation of OxyContin caused a number of opioid users to switch to illicit opioids. I believe that's been shown in other literature.

BY MR. ROTH:

Q. So how do you reconcile your model showing that there's actually no effect on MMEs from the reformulation of OxyContin with their opinion that it led to some massive shift of opioid users to illegal drugs like heroin?

MR. SOBOL: Objection.

A. Well, a couple of things. First, I believe the model that I put forward in Model B, which captures the environment,

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the environment I've generally been thinking about in the third era is one in which public health restrictions are tamping down on opioid use.

That's already being captured in that dummy trend that we talked about earlier, so some of that is getting picked up, as opposed to being able to pull it out separately just at that moment in time when the OxyContin reformulation occurred. So my model is already picking that up.

You know, I think the other thing is, of course, I'm looking at the opioid market as a whole, not just OxyContin on its own, and so there are -- there are other factors happening for other opioids.

BY MR. ROTH:

Q. But your model suggests that there was still a supply of opioids and prescribing driven by promotion whereas they're suggesting that the supply was drying up to the extent that users evaded the legal prescription market and turned to illegal drugs.

A. I don't believe you're correct

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in that statement. These models are looking at two very different things. I'm not looking at the use of illicit opioids. The data show decreasing use of legal opioids. That's -- that's just the underlying MMEs, so that is happening.

My model is looking at the portion of that that's explained by promotion, so there's no way that this is disproving people had left OxyContin.

Q. But it is showing that according to your model, the OxyContin reformulation did not have a statistically significant impact on the MMEs prescribed?

A. Once you control for the variables that I've controlled for, including price, including promotion, and accounting for the change in promotional effectiveness, I don't separately find an effect here. That is not the same as saying that OxyContin reformulation had no effect.

Q. Okay. So now I want to go back to Appendix D, and I want to start with Table D.1.

A. Okay.

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Q. All right. So Table D.1 --
A. Oh. I'm on page D1.
Q. Yeah, you've got to go past that.
A. Keep going.
Q. Talk about your charts and graphs.
A. It's okay. Excellent.
MR. SOBOL: This one?
THE WITNESS: All right.
MR. ROTH: Yeah, the table.
BY MR. ROTH:
Q. So first the chart, okay. So Table D.1 is a chart that I think explains Model A; is that right?
A. That's correct.
Q. And maybe just explain to me what is on here, because if I try to ask you a question, I'm not going do as good of a job as if you just tell me what this is showing.
MR. SOBOL: If you just ask a direct question.
A. Sure. These are SAS output made slightly prettier, and so at the top -- the top box there is describing the model

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overall, degrees of freedom, the total error, the sum of squared errors you see there, the mean squared error. After that, the square root of the mean squared error. These are all sort of talking about the variability in the data and the explanatory power of what's included. The R-squared and the adjusted R-squared are -- the adjusted R-squared accounts for the degrees of freedom, the number of covariants.
BY MR. ROTH:
Q. And what is in the bottom chart titled Nonlinear OLS Parameter Estimates?
A. Yes, so those the coefficient standard error, t statistic, p values. Those are reported way back in Table 1. They've just cleaned up a little bit.
So the coefficient estimate is the one that we're interested in, and then we'll mostly just focus on the p value.
Q. Okay. So if we flip to Figure D.1 --
A. Yeah.
Q. -- which is the line graph that's an output, I was perplexed when I saw

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this because the green line is predicted but-for; is that right?
A. That's correct.
Q. So you're showing negative but-for in the early '90s and again starting around 2012.
Do you see that?
A. Yes, that's correct.
Q. So what does that mean, that, you know, people were returning opioids? I don't even understand how that conceptually works.
A. Yes. Well, remember how I said that Model A uses a single promotional effectiveness and it doesn't fit the data very well? So it's an average that's smoothing over this long period and doesn't fit the data well, so that's what these predictions tell you. It's the same thing, in effect, as looking at the adjusted R-squared. This is just what it looks like in predicted values.
Q. So for this reason, Model A is not your preferred approach?
A. This is not my preferred model,

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that's correct.
Q. Yeah. I mean, conceptually, having a negative but-for doesn't actually make sense, right?
A. Conceptually, it's unappealing.
Q. How would you even calculate the difference with a negative but-for?
A. The same way. It's -- the difference would be just the space between the two lines. I have not done that here.
Q. Okay. So now if you flip the page to Table D.2, you'll see another set of charts.
And I think this correlates to your Model B; is that right?
A. That's correct.
Q. And I assume your description of what Table D.1 is would describe D.2, although this second chart has additional labels for the stock of promotion trends that we talked about earlier?
A. That's correct.
Q. Why is the stock of promotion dummy trend from August 2010 a negative number?

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A. Again, it's an erosion rate over the promotional effectiveness in b2, and so the promotional effectiveness is b2 plus the number of months from -- from that time break, August 2010, times b3. So it increments. You see what I'm saying?
Q. Yeah.
A. So every month, it's like b2 is reduced by 8.
Q. Right. And this is your time trend essentially that we talked about before?
A. It's sort of an erosion trend, yes.
Q. Okay. And why is it -- how did you come up with that number, like how do we get negative 7.97362?
A. It comes out of the regression model. It's estimated like all the other coefficients using OLS.
Q. And what is it doing? It's not like a Wald statistic? Or is it -- how does it mechanically estimate that coefficient?
A. Well, technically through matrix algebra. I mean, it's essentially

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picking up the association between, in this case, the stock of promotion times the dummy trend and sales. Like all the other coefficient estimates, the tests relate to the statistical properties of those estimates, but the coefficients really come from the correlations.
Q. All right. And then if we turn the page to D.2, this is the line graph from your Model B, which maps almost perfectly onto the blue flow of the data.
A. Yes.
MR. SOBOL: A thing of beauty.
MR. ROTH: Almost as if it fitted like a glove. All right.
BY MR. ROTH:
Q. Let's look at Table D.3.
A. Uh-huh.
Q. The last one of these. So this is -- well, it's not the last one of these, we'll ask about that in a second, but this is, I think, Model C.
A. That's right.
Q. Okay. So the same concept as D.1 and D.2 we just walked through?

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A. Yes.
Q. And then if you look at the second page, it looks like this one has something that says Type, Wald Test -- Test and Test0. What is that?
A. That's the joint test of significance of those events.
Q. Got it. Okay.
So when you say in your report jointly they're not statistically significant, it's based on this output?
A. Yes, except that that was in the errata, that that should have said they were significant.
Q. I saw that. That was the one errata where it changed like a no to a yes and there was --
A. Yes. It does not change my conclusions, but yes, you can see here the p value is .0176.
Q. Okay. So just to be clear, your opinion is that jointly the five events are actually statistically significant?
A. That's correct.
Q. Okay. And then if we look at

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D.3, Figure D.3, this is what your curve looks like in Model C?
A. Yes.
Q. Okay.
A. Not very different from Model B.
Q. Which makes sense because the baseline is Model B; you're just inserting five events and measuring those?
A. Yes. If they had had some effect, it might have looked different.
Q. Okay. You can -- looking at your report again, so we talked about this earlier, but you cited Datta and Dave, and we talked about that article this morning.
Do you remember that?
A. I do.
Q. So let's pull it out one more time. Probably the last one.
A. Let me make sure that I get the right...
Q. It's Exhibit...
A. 5. Got it.
Q. 5.
So if you look with me at

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page 452 again, we're now going to get to talk about endogeneity.
A. Excellent.
Q. You knew it was coming.
A. I did.
Q. So at the top of the page, they say: A key empirical concern in this literature relates to potential targeting bias, which physicians who already have a history of prescribing a particular drug or who have a higher unobserved likelihood of prescribing the drug (for instance, due to their patient population or practice type) more likely to be targeted by detailers.
Do you see that?
A. I do.
Q. And is that an empirical concern that you as an econometrician or economist would have?
A. If I were doing a physician-level study, yes.
Q. And one could describe this issue as something called endogeneity?
A. Yes.
Q. And can you define endogeneity

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for us?
A. Well, in effect, what they're talking about here, I described earlier this morning the endogeneity they're concerned about is of the type that physicians who are more likely to be detailed are already more likely to be open to prescribing or are, in fact, high prescribers already.
Q. And it's called endogeneity because that's an endogenous problem?
A. Yes. The level of detailing is endogenously determined with the level of prescribing.
Q. So continuing on their paper, they say "Addressing such endogeneity is a vital issue in identifying plausibly causal effects of advertising, which would otherwise lead to overestimates of the advertising response.
Do you see that?
A. I do see that.
Q. And --
A. And as I said before, it's because they're talking about physician-level data.

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Q. Which you didn't look at?
MR. SOBOL: Objection, asked and answered.
A. It was not relevant to my report because I have been asked to conduct an aggregate analysis.
BY MR. ROTH:
Q. And then they say: Studies that address this endogeneity in most cases have done so through an instrumental variables-based methodology, although as Bronnenberg caution, many of the instruments employed have limited variation and may not fully satisfy the validity requirements. This caveat notwithstanding, these studies generally find a smaller marginal effect of detailing relative to those that do not account for endogeneity.
Do you see that?
A. I do.
Q. Now, what about having an aggregate macro analysis means that endogeneity is no issue for you?
MR. SOBOL: Objection.
A. Well, endogeneity is something

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different in every context, so what they're describing specifically here, I mean, I think they say that they're talking about targeting bias, so that's the physician-level concern.
It simply doesn't exist in my data because I'm not looking at physician-level data. I cannot mistake the fact that Doctor A has high prescriptions compared to Doctor B, not because she's been detailed before, but she's been detailed before because she has high prescriptions. Because I'm only looking at the aggregate. So the only kind of endogeneity there, it can't be related to targeting. It has to be related to something else.
In other instances people have looked at endogeneity when it comes to a specific product. They said, well, you know, we knew that this product was going to be a blockbuster so we put our detailing on product A versus product B, and so that's the nature of the endogeneity. But again, I don't have that here because I'm aggregating across products.
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BY MR. ROTH:
Q. It's a convenient answer to everything, but I want to dissect that.
The data you're looking at --
MR. SOBOL: Well, objection to that.
BY MR. ROTH:
Q. The data you're looking at from IQVIA is an aggregation of detailing contacts to doctors, correct?
A. The details were made to doctors, yes.
Q. Or healthcare providers. Actually, could have been nurse practitioners, as we talked about earlier?
A. Yes.
Q. Why is it that adding up a whole suite of contacts to doctors is any less susceptible to the fact that certain doctors are more likely to be detailed in the first place than looking at it on a disaggregated individualized basis?
A. You're making me feel like I'm failing as a teacher. Let me try again.
MR. SOBOL: Yeah.

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A. It's the fact of measuring, detailing and prescribing at the doctor level and trying to examine that specific relationship that's causing the endogeneity problem.
So imagine that -- I'm trying to give a work example for you, but I mean, the concern again is that the patterns of high prescribing that we're observing between doctors are really causing detailing and not the other way around.
But if I am ignoring those patterns, the only thing that I'm looking at is increases over time. Those -- the forces that say which doctors get detailed are just not -- they're not in my data.
So it's like doing an intent-to-treat analysis, if that means anything to you. We have clinical studies where we know that some patients will be compliant and some won't, and if we only look at the effect of the drug on the compliant patients, we're going to misstate its population effect, so we look at all patients.

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That's basically what I'm doing is it may well be that targeting is happening here. If that is true, then the aggregate effect will be small. In the extreme, where promotion doesn't work at all, it just -- detailing -- we just, you know, detail the doctors we know are going to prescribe, then I would find no effect in the aggregate. Even though you would find an effect in the cross-section, you won't find it in the aggregate.
BY MR. ROTH:
Q. We may have to agree to disagree on this one for now. I can't promise we won't come back.
Do you agree that when endogeneity is an issue, it's typically handled through instrumental variables?
A. Yes, that is a classic approach. In effect, the instrumental variables are trying to step back from -- from that targeting to get to something that is, in fact, exogenous.
Q. Are there other options for addressing endogeneity?

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A. Well, generally, there's sort of broader research design, so ultimately, endogeneity concerns some kind of unmeasured third variable. I mean, there's simultaneity that has to do with sort of a different interpretation of endogeneity, but what we're talking about here is something else that we're not measuring. So endogeneity can be addressed by measuring whatever that thing is. So in the case of Datta and Dave, it could be historic prescribing.
Q. Did you take any effort to test for endogeneity issues or address endogeneity issues in your regression analyses?
A. Again, conceptually, I don't believe this is an issue looking at the overall opioid market over time, so I did not address endogeneity in my model.
Q. Do you know if anyone on your team did?
A. I do not.
Q. You've used the instrumental variables methodology to correct for endogeneity in other models you've developed for litigation, correct?

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A. In looking at a single drug, yes. As I mentioned, there's another version of the endogeneity story that makes sense for a single drug.
Q. So in Zyprexa, I think, for example, you used instrumental variables?
A. I'm afraid that was a long time ago. I didn't review that report for that.
Q. I can mark it just so we have it in the record.
(Whereupon, Deposition Exhibit Rosenthal-12, Rosenthal Declaration re: Zyprexa, was marked for identification.)
BY MR. ROTH:
Q. Exhibit 12 is your --
A. Wow.
Q. -- declaration from Zyprexa, Analysis of Class-Wide Impact and Estimation of Damages.
MR. SOBOL: Oh, wow. Memories.
A. I'm trying to -- do you know what the date on this is?
BY MR. ROTH:
Q. It is February 2007.

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A. Wow.
Q. 12 years ago.
A. That is a really long time ago. Yes.
Q. Okay. And if you look at your Zyprexa declaration -- and I will stipulate this is an excerpt, we didn't print the whole thing, but at paragraph 35 you talk about the fact that you developed a regression model, and then the equations in paragraph 37.
Do you see that?
A. Yeah, I was just looking at -- I was trying to remember whether this is a panel data model or not, but --
MR. SOBOL: Well, take your time then to refresh your recollection of your model from 12 years ago.
THE WITNESS: I will. Yes.
A. Yes, this is a panel data model for the atypical antipsychotic class.
BY MR. ROTH:
Q. And if you were to try to assess the effect of any individual defendants' promotion in this case, would you put together a panel data model similar to

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the one you used in Zyprexa to do that?
A. I have not thought about doing defendant-by-defendant analysis in this case. It was not part of my assignment. I'm not sure if that would be appropriate, again, because the interest here, even if we're looking at individual defendants, is on the overall -- on the market expansion aspect of their marketing.
Whereas in Zyprexa, we were very interested in the -- I'm trying to remember what words we used this morning -- business dealing is the way economists usually describe it. Marketers describe it something differently, but the market share shifts, those were relevant in Zyprexa because the question was not so much that Zyprexa was trying to grow the market, although there was some of that. It was about trying to encourage doctors to substitute Zyprexa in place of first-generation antipsychotics.
Q. For a manufacturer that was not part of the market before it grew and came into the market after it had been expanded,

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why is it the case in your model that that manufacturer is part of the aggregate analysis and not subject to some other type of causation allocation?
MR. SOBOL: Objection, asked and answered.
A. Nowhere in my assignment was I asked to look at liability for individual manufacturers. I'm only trying to quantify aggregate impact. To the extent that I subtract individual defendants, it's really only to get to a different whole, it's not to assign liability to an individual defendant.
BY MR. ROTH:
Q. So looking at the Zyprexa declaration, paragraph 42, you say: For purposes of the regression, the promotional variables for Zyprexa and its competitors were entered as discounted stocks following the tendency of the published literature and in accordance with the theory that promotions to physicians is habit building.
Do you see that?
A. I do.
Q. So you used a stock of

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promotion with a depreciation rate similar to here?
A. At least I'm consistent, yes.
Q. No doubt.
And then you also used a Fisher Ideal Price Index in that case too?
A. I did.
Q. But you weren't consistent next, because then you say: In addition, the estimation deals with two important issues, serial correlation in the error terms and the endogeneity of price and promotion. Serial correlation in the error terms require the use of time series methods to produce reliable estimates. The endogeneity of price and promotion was handled using the standard instrumental variables approach.
Did I read that correctly?
A. Yes, you did.
Q. And if endogeneity is an issue for you -- I understand you don't think it is -- but if it is an issue for you, your regression may lead to overestimating the response to promotion?
MR. SOBOL: Well, then,

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objection.
A. I do not believe endogeneity is an issue in my model for the reasons that I've described. But in particular, what we're looking at is an aggregate phenomenon, and so the theory of endogeneity that we would have to have requires this reverse causation on a month-by-month basis for the market as a whole, and I do not believe that's a plausible notion.
BY MR. ROTH:
Q. Okay. Don't fight the hypothetical, though.
Assume endogeneity is an issue with your model. What impact would it have?
MR. SOBOL: Objection, asked and answered.
A. I cannot imagine a form of endogeneity that would make sense in this case. I cannot understand how it could be that one month's sales could have caused the next month's detailing to change in the way that endogeneity requires. It's simply not a plausible set of ideas in this context.
///

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BY MR. ROTH:
Q. And why is that again?
A. Because we're looking at the market as a whole, and not individual manufacturers or individual drugs, where those decisions are made.
Q. I guess I'm confused, because earlier you talked about us as this manufacturing ecosystem that all kind of acts together, but now for purposes of endogeneity, you're saying there are no issues because we're not looking at it on an individualized basis, and I can't square those two things. Maybe you can help.
A. Sure.
MR. SOBOL: I'll object to the form, but go for it.
A. Sure. I think where you're confused is the ecosystem is causing prescribing in a way that may be concerted, but I -- I don't believe anywhere I have said that the defendants are aligning, explicitly, their marketing efforts.
BY MR. ROTH:
Q. Okay. Do you remember if you

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used an instrumental variables approach to address endogeneity in Neurontin?
A. All not quite 12 years ago, 17, however many, but I believe the answer is yes, in the circumstance of -- thank you, can you remind me -- the circumstance is very similar to the Zyprexa matter.
Q. Yes, so we can do this one quickly.
A. Yes.
Q. But Exhibit 13 is your Neurontin declaration, excerpted.
(Whereupon, Deposition Exhibit Rosenthal-13, Rosenthal Declaration re: Neurontin, was marked for identification.)
A. It's in Calibri too.
BY MR. ROTH:
Q. It must be the Greylock computers. Did Greylock McKinnon assist you there?
A. Yes.
Q. August 2008.
So looking at your Neurontin declaration, you were addressing alleged

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fraudulent promotion on behalf of the class plaintiffs; is that right?
MR. SOBOL: Actually, may I just interrupt one second? Sorry.
So is this pulled online or -- it indicates confidential in the bottom left-hand corner.
MS. VENTURA: It's available online.
MR. ROTH: Yeah, we got it online.
MR. SOBOL: Okay, go ahead.
THE WITNESS: Zyprexa too?
MR. ROTH: I think so. I did ask that question.
MR. SOBOL: Zyprexa had at the top an ECF thing. This one didn't. That's why I asked. I'm sorry. Go ahead.
BY MR. ROTH:
Q. So in Neurontin, you offered opinions on behalf of the class plaintiffs related to the defendants' promotion; is that right?
A. And coordinated plaintiffs -- I

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was just trying to see -- yes, that's right.
Q. And then your regression is in paragraph 34.
A. Yes.
Q. And then in paragraph 40, under Prices, there's a sentence toward the end that says: The endogeneity of price and promotion was handled using the standard instrumental variables approach.
A. Yes, that's correct.
Q. And that's actually a different endogeneity than what Datta and Dave were describing.
A. That's correct.
Q. And is that endogeneity an issue for you here?
A. I think again, because we're looking at a market average set of prices, that that is not the same as thinking about the simultaneity of price and quantities for an individual manufacturer.
Q. Okay. I've got one more source for you. We're just taking the time machine into the farther back.
A. Oh my gosh, is there farther

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back? Yes.
(Whereupon, Deposition Exhibit Rosenthal-14, 2003 Kaiser Family Foundation Report, was marked for identification.)
BY MR. ROTH:
Q. Exhibit 14, Demand Effects of Recent Changes in Prescription Drug Promotion, the Kaiser Family Foundation, and you are one of the authors.
Do you see that?
A. I do.
Q. And Professor Berndt is a co-author of yours.
A. That is correct.
Q. And in this article, it looks like you're analyzing whether increases in direct-to-consumer advertising increased the market share of an entire therapeutic class, right?
A. Yes. So maybe just briefly, this analysis is a panel data study. We have a couple of years of data, I think three years of data, for five different classes of drugs. And we do the analysis both at the

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class level and then at the individual product level.
Q. But at least a part of this was aggregated, correct?
A. At the class level, yes.
Q. Okay. Let's look at page 14.
MR. SOBOL: What about page 1? It's got a quote from Kessler on it.
MR. ROTH: Look at that, David A. Kessler, along with laureates Thomas Jefferson and F. Scott Fitzgerald.
THE WITNESS: It would not be appropriate to comment on the quotations in this paper.
BY MR. ROTH:
Q. So page 14 --
MR. ROTH: Hold on.
(Comments off the stenographic record.)
BY MR. ROTH:
Q. Hold on, Professor. I am on the wrong page, I think.
A. Okay.
Q. Or hopefully not on the wrong

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prescribing?
A. I'm sorry, can you explain what -- what that would look like?
Q. You're the economist. You probably have a better idea of how to put that into a study. But is that something you considered doing?
A. What is --
MR. SOBOL: Objection to the form.
You're the lawyer. What's illegal?
THE WITNESS: Yes, sorry, that's my question.
MR. ROTH: I asked both of you.
A. Well, as I understand this case, it is not about illegal prescribing but illegal promotion, and those are two different things.
BY MR. ROTH:
Q. Right. But you understand that there are doctors who have been criminally convicted for illegally prescribing opioid products?
A. I -- yes, I do know there have

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been some prosecutions.
Q. And you don't have any variable in your model to account for that?
A. I do not account for that in my model, no.
Q. You don't have any variable in your model to account for diversion of lawfully prescribed drugs to someone other than the intended user?
MR. SOBOL: Objection to the form.
A. Just to be clear, when -- when thinking about what to put in a model, one reason we might do it is we want to say this is something separate from the variable of interest.
But if, in fact, the allegedly unlawful marketing caused diversion, then it would not be appropriate to pull it out from the model.
BY MR. ROTH:
Q. Right. But you could conceive of a set of facts where diversion occurs in the setting of perfectly lawful marketing and prescribing?

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A. Well, my model is currently agnostic as to whether the prescriptions caused by the unlawful conduct were diverted or not. It seems to me that it's a legal question about, you know, whether it would be appropriate to separately identify those.
As we started out our conversation today, it makes sense to me as an economist that what -- whatever happened with those prescriptions after they left the pharmacy, the fact that they generated profits for the defendants is a reasonable basis for recovery, again, on the notion that recovery is intended to deter this kind of conduct in the future.
Q. Does your direct model have any variable for formulary placement status?
A. It does not.
Q. Your direct model does not have any variable for prescription drug coverage?
A. As we discussed earlier, these are not factors that I would expect to be changing over time in a way that would predict the sales of opiates as a class, so if there are formulary changes, that may

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result in more generics, more of the preferred brand versus the nonpreferred brand. I don't believe that those are appropriately captured in a model like this.
Q. Okay. Why do you prefer Model B to Model C?
A. In part, because of that counterintuitive effect that we talked about before, with -- now I can't remember if it was oxycodone or hydrocodone.
Q. I think it was the hydrocodone rescheduling.
A. I think it was hydrocodone, yes.
So that suggests to me that that's -- whatever it's doing, it's not picking up what I think it's supposed to be doing.
It makes almost no difference in the predictions, we looked at those charts before, and you can see in the adjusted R-squared there's almost no difference, but it's -- to me it looks like it's not the right way to capture the effect of these events.

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BY MR. ROTH:
Q. And, actually, I think Model C has a slightly higher adjusted R-squared than Model B.
A. Yeah, just to be clear, it's one ten-thousandth of a point.
Q. But it is higher.
A. It is technically higher.
Q. If you were to put more of the events from Figure 5 into what is Model C, would that not be a fairly robust test of the predictiveness of Model B since Model C is really just Model B with the events added?
A. I guess I don't understand your question. If I were to put more events in Model C, would that be another test of Model B?
Q. Right.
A. I think the fact that -- that adding a subset of events that were, you know, displaced over time doesn't change ultimately the predictions in Model B, suggests to me that it's not going to be worthwhile.
And again, the counterintuitive

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coefficient on the hydrocodone rescheduling suggest to me also, as we continue to add more events, we'll get a certain amount of gobbledygook. I mean, that's just going to be true in a time series model.
In any econometric model, the goal is to include the important factors but be as parsimonious as possible. Adding all these events would not be parsimonious.
Q. I think I heard you a minute ago say that you rejected Model C in favor of Model B in part because of the hydrocodone rescheduling. Is there anything else that led you to make the decision that Model B was preferred?
A. It adds almost nothing.
Q. So it's really a function of almost essentially the same R-squared and you get this wonky result with hydrocodone's rescheduling that leads you to prefer Model B?
MR. SOBOL: Objection, asked and answered.
A. That's -- yes, that is in effect correct. I look at the two models, I

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see that they give almost the same predictions, the same actual predicted and but-for predicted, and it seems to me that Model C is not well specified in those five events, that they don't seem to work in the way that they're specified there, which is that they start happening at a point in time.
BY MR. ROTH:
Q. And yet, your breaks also occur at a point in time?
MR. SOBOL: Objection.
A. The breaks are doing something entirely different because they're interacting with promotion. They're saying, you know, we've estimated this underlying effectiveness of promotion and does that relationship shift at a point in time.
BY MR. ROTH:
Q. Okay. Model B suggests an R-squared of 99.36%.
A. Yes.
Q. So your model explains more than 99% of the variation in MMEs with promotion?
A. That's correct, and price.

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Q. So less than 1% of opioid MMEs are explained by anything but price and promotion?
A. That's correct.
Q. And you conclude that the predictive power of Model B is shown to be quite good?
A. Yes.
Q. Have you tried running your model removing promotion and just having price in the model?
A. I have not.
Q. If it showed negative MMEs, what would that mean for your model?
A. If we're removing promotion and -- I mean, I guess as we talked about in looking at Model A, it would suggest that there was something that's missing from the model. When we looked at the but-for MMEs as negative, that clearly it is not doing a good job of predicting the real world in which there were positive MMEs.
Q. What is overfitting?
A. Overfitting is when you include factors in the model such that you perfectly

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predict the dependent variable, that you've saturated the model, which is why I don't add more events to this model, where it's already high. Having an adjusted R-squared as high as we do in this case in a time series model is quite common.

Q. How do you tell to see if a model is overfit?

A. I don't actually, as I sit here, recall the specific test for overfitting, but usually it's about predicting out of sample and looking at how well the model forecasts.

Q. How does the R-squared of your model in this case compare to R-squareds you have from other models you've done of promotion against sales?

A. I don't recall specifically, but I think we probably have a few in front of us that we could look at.

Q. Yeah. I mean, does 99.36 strike you as one of the higher R-squareds you've had or are all of your models perfect in their predictions --

A. Model A has an R-squared of

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88 -- well, 87.99, the adjusted R-squared. So we have a range here. Again, time series models do typically have very high R-squareds. I don't know what they've been in other models.

As we talked about before, this is unlike the model, for example, that we did in the Kaiser Family Foundation report where we're looking at a couple of years for about 25 drugs and exploiting both time series and cross-sectional variation.

Q. You understand from the literature that a very high R-squared in the presence of substantial unmodeled autocorrelation can be an issue?

A. I think we've already talked about the error structure here, and my understanding is that my team looked at that early on and concluded that it was not a problem here.

Q. Who from your team did that work?

A. That would be Forrest McCluer.

Q. And what specifically did Mr. McCluer do to test for autocorrelation?

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A. Well, as we were talking before, he was looking at the correlation over time of the errors in the model.

Q. And did you see the results of his work?

A. I did not see the results specifically, no.

Q. Is your direct model a linear model or a nonlinear model?

A. Well, it's nonlinear because of the depreciation rate. It is effectively run using ordinary linear -- ordinary least squares, but it's nonlinear because of the interaction of the depreciation rate.

Q. Is R-squared an appropriate measure for nonlinear models in econometrics?

A. The adjusted R-squared that we report here is appropriate for this model.

Q. Okay. Let me mark as Exhibit 18 an article from Spiess and Neumeyer, An evaluation of R-squared as an inadequate measure for nonlinear models in pharmacological and biochemical research.

(Whereupon, Deposition Exhibit Rosenthal-18, 2010 Spiess and Neumeyer

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Publication, was marked for identification.)

BY MR. ROTH:

Q. Do you see that?

A. I do.

Q. The title sounds pretty relevant.

Were you aware of this paper?

A. Not specifically.

Q. Okay. So this is a 2010 paper in BMC Pharmacology. It looks like Spiess and -- is from the Department of Andrology at the University Hospital Hamburg-Eppendorf in Germany.

Do you see that?

A. I don't actually see where the authors --

Q. I'm looking at the footnote.

A. Uh-huh, yeah.

Q. Okay. So at page 1, at the very bottom of the first column under Background, it says: Although it is known now for some time that R-squared is an inadequate measure for nonlinear regression, many scientifics and also reviewers insist on

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Do you see that?
A. Yes.
Q. Which is zero percent of the contacts because it's obviously lower than one-hundredth of a decimal place of the contacts?
A. Yes.
Q. And still there's [redacted] MMEs that are associated with oxycodone.
Do you see that?
A. Yes. It's --
Q. Go ahead.
MR. SOBOL: There's no question before you.
A. Yes.
BY MR. ROTH:
Q. Well, and then we can see like in Kadian, you've got [redacted] contacts which is [redacted], and that's associated with [redacted] MMEs, right?
A. Yes.
Q. And you're not drawing any conclusion about the effect of this extremely small percentage of promotion and the number of MMEs prescribed for those drugs, are you?

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A. I think I've been extremely clear that my analysis is an aggregate analysis of the entire opioid class.
Q. So where it says [redacted] MMEs for oxycodone, what is that number? Is that all generic oxycodone from 1993 to 2018?
A. Sold by Actavis.
Q. Okay. So all oxycodone sold by Actavis based on counsel and Mr. McCluer's assignment of drugs is in the MME column, and there's [redacted] promotional contacts in the data?
MR. SOBOL: Objection.
A. Well, again, instruction from counsel identified the defendants. You can see here that oxycodone is -- the manufacturer is just Actavis. It seems uncontroversial to me. But yes, there are [redacted] MMEs of oxycodone that Actavis sold between 1993 and 2018.
BY MR. ROTH:
Q. So can you tell without digging into the guts of the model what share Actavis is being allocated for its [redacted] oxycodone contacts in your model?
MR. SOBOL: Objection.

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Objection.
A. Well, you can see it rounded here to two decimal places. The share of contacts is obviously de minimis.
BY MR. ROTH:
Q. But in terms of the way the shares work in your Table 3, are you looking at percent contacts to come up with that number? You're not; you're doing a revised but-for analysis.
MR. SOBOL: Objection.
A. Yes, but the two things are not disconnected. So the way I construct Table 3, as I mentioned before, is not allocating on the basis of MMEs. It's about rerunning the but-for model and altering the inputs in terms of detailing.
So the [redacted] contacts for Actavis are backed out when I back Actavis out of the model in Table 3, so that all of the contacts that you see here associated with Actavis, that is what gets backed out of the model.
BY MR. ROTH:
Q. So the [redacted] of promotional contacts?

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A. [redacted] yes.
Q. So how is that resulting in an overall allocation in Table 3 of [redacted]
MR. SOBOL: Objection.
A. [redacted] -- well, I'm sorry. I'm afraid you misunderstand Table 3. So let me go back and explain Table 3 again.
So Table 3 starts out with the same aggregate impact measure that I calculate in Table 2, right, so that's the -- if all defendant promotion did not occur, here's what percent of units would not have been sold.
And then in Table 3, then I say, okay, well, what if, in fact, the [redacted] of detailing that Actavis was responsible for according to my analysis -- what if that's actually -- that doesn't get affected. That stays in the model. Then I run another prediction. These are econometric predictions based on Model B, and so the [redacted] whatever percent, [redacted] now that's the aggregate percent of all MMEs if Actavis' conduct is no longer subject to recovery.
///

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BY MR. ROTH:
Q. So to figure out what percentage of causation each manufacturer's having, you actually have to subtract the percentage that you come up with from that analysis from the baseline?
MR. SOBOL: Objection, mischaracterizes the testimony.
A. If you wanted to know how much -- how many MMEs Actavis' conduct specifically caused in the market overall, you would subtract those two numbers.
BY MR. ROTH:
Q. So you would get [redacted] which is close to the [redacted] of promotional contacts?
MR. SOBOL: Objection.
A. That's correct.
BY MR. ROTH:
Q. So essentially -- and we can do this defendant by defendant, but it looks like your allocations are just mirroring how much each of these defendants promoted?
MR. SOBOL: Objection.
A. Well, they are not, but -- but it should be obvious that because the

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challenged conduct is promotion, that if we look at taking defendants out of the impact analysis, that the results would be proportional to promotion, because that's the thing that's being challenged.
BY MR. ROTH:
Q. So whoever has the most detailing contacts in the IPS data is going to get the highest share under your Table 3?
MR. SOBOL: Objection.
A. Well, again, Table 3 is not framed or interpreted as telling you how to allocate damages. It is intended for the court to see, A, that it's possible to move defendants in and out of the analysis, and, B, what those effects would be.
Whether or not damages are allocated on the same basis, that is something about which I know nothing.
BY MR. ROTH:
Q. Okay. So we talked about allocating the detailing contacts, and I assume the questions I asked you about the process for doing that would be true whether we're talking about between defendants or

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between defendants or non-defendants, it was Mr. McCluer with instruction from counsel reviewing the sort of documents we just reviewed here today?
MR. SOBOL: Objection. What's the question?
A. The --
MR. SOBOL: No, I don't know what the question is. Is there a question? Or you want to just say "correct" at the end?
MR. ROTH: I mean, come on. All right.
BY MR. ROTH:
Q. I asked you questions about how detailing contacts were allocated. Is the process you described the same whether we're talking about allocating among the defendants or between the defendants and non-defendants?
A. The process of identifying what -- in effect, what contacts should be assigned to defendants was with counsel, and it was ultimately counsel's advice. Mr. McCluer assisted because he had the granular data, but ultimately, the

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identification -- I mean, I'm not sure why it's different to say the identification of what pieces of -- what products belong with what defendants and what products belong to non-defendants. That's all one process.
Q. Okay. How does your model allocate generic drugs?
MR. SOBOL: Objection.
BY MR. ROTH:
Q. The same way as we just discussed?
MR. SOBOL: Objection.
A. I don't know what you mean by allocate. My model measures the aggregate impact of the challenged --
BY MR. ROTH:
Q. I should say it differently. How does Table C identify and associate generic drugs with manufacturers?
MR. SOBOL: Objection.
A. Table C, I mean, the process for identifying the manufacturers and the drugs is the same for generics as it is for brand name drugs. Those generic manufacturers are identified in the IPS --

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sorry, in both the IPS and the NPA data.
BY MR. ROTH:
Q. And then looking back on Exhibit 19, you reference that the marketers were associated with entities pursuant to marketing arrangements. What did you review on that score?
A. I relied on counsel for that information.
MR. ROTH: I tell you what, why don't we take five more minutes, because I think it would benefit for streamlining.
THE WITNESS: Okay.
THE VIDEOGRAPHER: The time is 4:57 p.m. We're now off the record.
(Recess taken, 4:57 p.m. to 5:15 p.m.)
THE VIDEOGRAPHER: The time is 5:15 p.m. We're back on the record.
BY MR. ROTH:
Q. To close the loop on this, Professor Rosenthal, Table 3 is the output of Appendix C and the way that promotional visits and MMEs are affiliated with the

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defendants or non-defendants; is that right?
MR. SOBOL: Objection.
A. I guess I wouldn't say that exactly. Table C reflects the underlying data structure that allows us to parse defendants individually and collectively from non-defendants in the promotional data.
Table 3 then relies on that structure to produce alternative but-for percentages.
BY MR. ROTH:
Q. The purpose of putting Table C together was to create Table 3?
MR. SOBOL: Objection.
A. I'm not sure that was its sole purpose. It was to be transparent about how we are allocating drugs and their associated promotion to defendants.
BY MR. ROTH:
Q. Table 3 does not allow for a defendant-specific breakdown of the effect of that defendant's promotion, correct?
MR. SOBOL: Objection.
A. Table 3 provides an aggregate measure of impact associated with defendants'

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promotion; it does not disaggregate that across sales.
BY MR. ROTH:
Q. And I think you said earlier, for that you would have to do a disaggregated model, and that's not something you were asked to do, nor something you did?
MR. SOBOL: Objection, form, mischaracterizes the prior testimony.
MR. ROTH: Okay. Let me try it again.
BY MR. ROTH:
Q. In order to analyze the effect of a specific defendant's promotion, you would need to look at a defendant-specific model to correlate its promotion to MMEs?
MR. SOBOL: Objection, mischaracterizes prior testimony.
A. Well, I don't think so. What I have done, as you know, in the aggregate is to look at all promotion and the extent to which it impacted all sales.
And then in Table 3, the only thing I'm trying to do is to identify if we moved some set of promotion from the okay

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column -- from the not okay column back into the okay column, how that would affect my aggregate impact.
So I am looking discretely at defendants' promotion. But because I'm interested in impact, whether or not it was increasing my sales or increasing your sales, I have, appropriate to my assignment, included both of those things in that impact analysis. I have not been asked anywhere to calculate the effect only on own sales.
BY MR. ROTH:
Q. Table 3 allows you to assess the impact of an individual defendant's promotional contacts on the aggregate promotion and aggregate MMEs?
MR. SOBOL: Objection, asked and answered.
A. Yes, that's correct. And just to be clear, as we talked about before, the purpose of Table 3 is not to allocate to defendants. I don't know how damages ultimately will be allocated, but to demonstrate that I could remove the conduct of one of the defendants and still calculate

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aggregate impact.
BY MR. ROTH:
Q. And, in fact, Table 3 does not even allow you to isolate the impact of an individual defendant's promotion alone on the aggregate; it simply shows you the proportion of that individual defendant's promotion to the aggregate?
MR. SOBOL: Objection, form, asked and answered.
A. I don't think that's correct. As we talked about before, this is not the purpose of the table. But if you were to look at the but-for percentage including Purdue versus the but-for percentage excluding Purdue, you would see the increment that is due to Purdue's conduct.
BY MR. ROTH:
Q. And that's essentially based on Purdue's share of the promotional contacts in the data?
MR. SOBOL: Objection, asked and answered.
A. That is the way the aggregate model works, yes. It looks at all detailing

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and their effect on all sales.
BY MR. ROTH:
Q. It's akin to a market share analysis on the promotional data and the number of contacts a given defendant has?
MR. SOBOL: Objection, form, asked and answered.
A. Well, it's not strictly speaking because the model has this time series structure that marketing that occurs at one point in time is not the same as marketing that occurs at a different point in time. So it's not, strictly speaking, proportional.
BY MR. ROTH:
Q. But it is essentially a market share analysis of each defendant's share of contacts as modified by the time series structure that you've imposed that we talked about earlier today?
MR. SOBOL: Objection.
A. I just can't agree with that statement. It's not a market share analysis. It is the result, the output of a time series analysis of the effect of marketing on sales,

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and -- and then I alter a set of underlying assumptions about what is in and what is out.
But it comes out of -- out of this econometric model. It doesn't -- it's not simply a market share analysis.
BY MR. ROTH:
Q. If you took all of the defendants out of the model except for one, what would the result of your table be?
MR. SOBOL: Objection.
A. Another number. I haven't done that.
BY MR. ROTH:
Q. I mean, would that defendant not just get the entire [redacted] or would there be some other...
A. No, that's not the way the model works.
MR. SOBOL: Objection.
BY MR. ROTH:
Q. Okay. But it wouldn't be -- that would not be a defendant-specific model; that would just be isolating how your aggregate model works when you just consider one defendant's promotion?

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A. Well, again, the aggregate model would be the same, and if we said that all the defendants were no longer going to be subject to recovery except one, then we would be left with the -- whatever the effect of that defendant's promotion on sales was.
Q. Have you compared the results of altering your aggregate model using Table 3 on a defendant-by-defendant basis with each defendant's share of promotional contacts in the data?
MR. SOBOL: Objection, asked and answered.
A. Well, I think when you and I were talking before the break, you made some observation, but I have not, no.
BY MR. ROTH:
Q. Okay. When were you retained by the plaintiffs in this case?
A. In the summer. I'm not sure the date on the letter, but in the summer of 2018, sorry, to be clear.
Q. Who was it that retained you?
A. I was retained by co-counsel. There are two Pauls and Joe Rice, and one of

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them is a Hanly, but I can't remember all their names.
Q. Okay. Did you personally draft your expert report?
A. I did.
Q. And did anyone else assist you in the drafting of the report?
A. I had some assistance from my staff, yes.
Q. And you've mentioned your staff. We said that was Greylock. Can you just give us the names of all the people who were on your staff?
A. Sure. Yes, of course. Forrest McCluer, who is the senior economist they mentioned earlier, particularly around the technical aspects of the report. I believe I would have had some assistance, for example, in summarizing the complaint from Renee Rushnawitz.
Q. Can you spell that?
A. Yes, R -- well, Renee, is R-E-N-E-E, and then Rushnawitz, R-U-S-H-N-A-W-I-T-Z.
Q. Okay. Anyone else?

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A. Not that I know of, but there are -- there are junior staff, for example, who work with Forrest and Renee, so I think if you looked, you might see that there were junior staff pulling articles, doing that kind of thing, but not involved in drafting.
Q. So I understand from earlier today and attending their depositions that there was some amount of coordination you did with Professors Cutler, Gruber and McGuire filing these reports; is that right?
A. Yes.
Q. Did you meet with each of the three other professors about your reports in person before March 25th?
A. Yes, we had meetings with counsel.
Q. Do you recall how many meetings you had with one or more of the Professor Cutler group or McGuire try up frustrate prior to March 25th with or without counsel present?
A. I believe there were perhaps four face-to-face meetings from the time I was retained to the filing of the report. It

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may have been five.
Q. And in addition to the four to five face-to-face meetings, did you speak with Professors Cutler, Gruber or McGuire about either your work or their work on this case?
A. We had conference calls with that group and with counsel for a period that were weekly.
Q. And do you recall how long the in-person meetings were?
A. Those in-person meetings I think were -- they were largely half day meetings.
Q. And during those meetings, did you present your analyses to each other on slides or were they just conversations? How did those meetings work?
MR. SOBOL: Just generally, without the content.
A. Generally there were high-level presentations and discussions.
BY MR. ROTH:
Q. And did you discuss with them in general terms the analyses that ultimately

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became the output of your expert report?
A. Yes.
Q. And the models you would run and the approaches you would take?
A. Yes.
Q. And I assume they shared their approaches and models and general report structures with you too?
A. Yes.
Q. Did you review drafts of any of their reports and did they review drafts of your reports?
A. I -- what was the question.
MR. SOBOL: With or without counsel?
A. Review drafts with or without counsel?
MR. SOBOL: Well --
BY MR. ROTH:
Q. Were there drafts reviewed? I know I'm not going to get the drafts. I just want to know if you reviewed each other's drafts?
MR. SOBOL: Sure.
MR. ROTH: And did the realtime

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Q. And then the bureau of labor statistics that's also used in the indirect model?
A. Yes.
Q. The ARCOS data is in the indirect model. What is this health resources services administration Area Health Resource File?
A. The Area Health Resource File is sort of a metadata file. It includes data from other sources to describe various dimensions of county-level health systems, health measures. So we also used that in the indirect model, and I actually have to look to see if we used in the Section X.
Q. And then what about the CDC surveillance epidemiology and end result dataset?
A. Those data track cancer, cancer epidemiology.
Q. How did you get access to the electronic data that you list in Attachment B?
A. Attachment B includes some publicly available data that anyone can

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obtain through the Internet, so that would cover the ARC data, the ASEC data, the SEER results, because we're not getting the SEER microdata; they're aggregated. And certainly the morphine milligram equivalence from the CDC is publicly available data, the Area Health Resource File is publicly available data.

The ARCOS data we obtained through compass lexicon, the IQVIA data counsel purchased on our behalf. They won't sell it to us directly for litigation purposes. They will sell to counsel.

Q. And the --
A. And the INCB are public.
Q. And did you discuss with counsel purchasing any additional IQVIA data than the three set that you analyzed, IPS, NPA or NSP?

MR. SOBOL: I instruct her not to answer.

MR. ROTH: I asked her if she talked about it.

MR. SOBOL: Well, it would carry the implication of the content

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of the conversation.
BY MR. ROTH:
Q. Are you aware that you've sells data beyond those three datasets that were purchased?
A. Yes. I am aware they sell other datasets.
Q. Okay. Did you sign any protective orders to get access to the ARCOS data?
A. I did not, no.
Q. And have you signed any data use agreements related to any of the data you looked at?
A. No, but I don't know to what extent, for example, the people who actually have the data have signed those data use agreements so I don't touch the data.
Q. I didn't see any depositions from any of the Cuyahoga or Summit County witnesses on Attachment B, so I assume you didn't review those?
A. I did not.
Q. Did you interview any of the employees with other Summit or Cuyahoga

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County?
A. My analysis is a national analysis of the effect of detailing on sales, so interviewing people in the bellwether counties would if the really not make sense as part of what I'm trying to do.
Q. And you didn't rely beyond the seven depositions you list any other depositions in this case related to defendants' marketing efforts?
A. Again, I -- I don't find those to be relevant to the main affect the here, which is a quantitative analysis, and as I noted in my report, economists generally proceed using data to tell what people have done in response to a stimulus rather than by asking them to talk about it.
Q. What did you do to prepare for your deposition today?
A. I reviewed my report, the documents I rely on, including the articles, basically everything in this Attachment B, and I had conversations with counsel.
Q. Okay. Turning back to page 10 of your report, which is the handy summary

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chart?
A. Yes.
Q. Do you do this for every report?
A. I -- it's -- I like a handy summary table. It's something that is -- that we do often in writing federal grants.
Q. I will tell you this is excellent and I'm going to start forcing some of the experts that we have to start doing this?
MR. SOBOL: It's the only thing I understand in the whole report.
MR. ROTH: It's nice, it's a one-pager.
BY MR. ROTH:
Q. So recognizing there's a lot of nuance here, and we've already been through your direct model fairly exhaustively and we'll do the same for the indirect and the Section X analysis tomorrow?
A. Yes.
Q. I want to touch briefly on Section VII for a minute?
A. Okay.

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Q. Okay. So Section VII, you reviewed literature on the marketing of opioids and shared examples from discovery that corroborate the economic theory and evidence on pharmaceutical marketing. That's what you said, right?
A. Yes.
Q. And we've talked about some of that literature here today?
A. We have. We haven't gone into detail on the transfers of value literature related to opioids, but we can.
Q. It's a tomorrow topic, unless you want to stay late?
A. No, that's fine.
Q. But then on the discovery materials, you know, you said you had very specific requests for what you looked at.
Are those the documents you looked at to come to the conclusions you do in Section VII of your report?
A. Yes. The documents that I cite in Section VII -- and again can you tell that my quantification of the effect of promotion on sales doesn't rely on some measure from

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this analysis, but this serves to give some justification for the theory that I'm pursuing that promotion affects sales and that there are multiple mechanisms involved.
So I review them, I would say in Section VII with that purpose in mind, not with the purpose of being exhaustive.
Q. Yeah. And I think you said earlier you're not marketing expert, right?
MR. SOBOL: Objection.
A. I am not here to offer an expert opinion on marketing. I think Dr. Perri does that.
BY MR. ROTH:
Q. Okay. And to the extent that you're offering comments in Section VII.B of your report from paragraphs 43 to 48 related to defendants' marketing documents, that's really did you know with an eye toward corroborating what the economic literature shows in -- as you analyze in Section VI about the relationship between promotion and sales?
A. Again, this was not intended to be an exhaustive analysis, but to show that

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the documents provide examples both of the economic idea that promotion is intended to grow sales and of the multiple marketing mechanisms that defendants use, so it corroborates other -- other ways that I have described the mechanism of interest here.
Q. Beyond reading the documents themselves, what other analytical approach did you take to assessing defendants' materials regarding the effects of promotion?
A. Well, as I just said, I don't use this analysis as an input in a quantitative way to my subsequent analysis. It is relate intended as you would see in any economic paper as a review of the institutional landscape that justifies the particular model and sets up the empirical analysis in a more qualitative way.
Q. It's not really a separate opinion as you bulleted it out. It's more context for the opinions that follow; is that fair?
MR. SOBOL: Objection.
A. Again, I think an institutional analysis is a part of most -- most reports

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OHIO
EASTERN DIVISION

IN RE: NATIONAL PRESCRIPTION OPIATE LITIGATION	)	MDL No. 2804
	)	Case No. 1:17-MD-2804
THIS DOCUMENT RELATES TO ALL CASES	)	Hon. Dan A. Polster

Sunday, May 5, 2019

HIGHLY CONFIDENTIAL - SUBJECT TO FURTHER CONFIDENTIALITY REVIEW

Videotaped Deposition of MEREDITH B. ROSENTHAL, Ph.D., VOLUME 2, held at Robins Kaplan LLP, 800 Boylston Street, Suite 2500, Boston, Massachusetts, commencing at 8:04 a.m., on the above date, before Michael E. Miller, Fellow of the Academy of Professional Reporters, Registered Diplomate Reporter, Certified Realtime Reporter and Notary Public.

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is not actually an industrywide model, is it?
A. Again, industrywide for the opioid industry?
Q. Well, except you take out all of the non-defendants from your model?
A. Well, that's not true. The model is all of the -- all of the opioids. The but-for scenario takes -- leaves the non-defendants as they were, but the model concludes all of them.
Q. Right. So in the but-for scenario where you take out the non-defendants, what did you do to compare their promotional activities to the defendants' promotional activities?
MR. SOBOL: Objection.
A. Well, such a comparison is not part of the overall analysis. Again, we've talked about the Table C, which presents the marketing by defendants and non-defendants, so the data are in there.
The model itself includes marketing for all opioids, and the but-for scenario simply disaggregates and identifies as a part of that process the marketing of

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non-defendants, but it does so only to generate different predictions of what sales would have been, so there -- I did not make a statistical comparison between non-defendant and defendant promotion.
BY MR. ROTH:
Q. When you removed the non-defendants, what did you do to confirm that that did not take out, for example, the non-rivalrous marketing and leave you with a set of just the rivalrous marketing?
MR. SOBOL: Objection.
A. What I'm examining in my aggregate model is the net effect, rivalrous market expanding of promotion, and so the model calculates that average market expansion effect and essentially all of the rivalrous marketing, it nets out by definition because to the extent that we're talking about rivalrous marketing as defined as moving market shares from one drug to the other, which is basically the definition of rivalrous marketing, all the pluses have to net out with the minuses.
And so that -- that does not

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appear in the output of my model because it's not relevant to my assignment. So by taking out all of the -- actually, technically, it's sort of a double negative. I actually leave in all of the non-defendant promotion in the but-for scenario because it would have happened regardless of whether the allegations are true or not.
By leaving that in, if it has rivalrous components to it, if it has market expanding components to it, whatever that is will show up in my predictions.
BY MR. ROTH:
Q. Yeah. What I'm trying to understand is I think we agree that when you look at an individual manufacturer there could be endogeneity issues in the form of price or in the form of detailing physicians who are predisposed to prescribe their product?
A. If we were looking at an individual manufacturer, we could have some of those endogeneity concerns, but I do not look at an individual manufacturer.
Q. I understand that.

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Even if we look at a group of manufacturers, we would still have endogeneity concerns to a degree?
MR. SOBOL: Objection. Excuse me. Asked and answered.
A. It's my opinion that in this -- when we're looking at the level of the entire opioid industry, that the conceptual basis for such endogeneity concerns is really not there, and even -- even if at the second stage of my analysis I parse out some subset of defendant, of manufacturers, sorry, non-defendants, in particular, that in and of itself doesn't raise a new endogeneity concern. The model is estimated on the marketwide effects.
BY MR. ROTH:
Q. I'm trying to figure out where the line is though. So like how many manufacturers need to be included for all of the endogeneity and rivalrous marketing issues to just net out and show market expansion as opposed to the effects of just the subset you're looking at?
MR. SOBOL: Objection to the

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form.
You can answer.
A. The rivalrous marketing will always net out. Again, it's just mathematically true that by definition, marketing that only moves market share, it has to net out. So that's just an identity.
That will always be true when we look at any subgroup of products that we -- that the rivalrous piece will net out. It just has to.
BY MR. ROTH:
Q. What about endogeneity?
A. The endogeneity issue in my opinion is where we have the entire opioid class in the analysis. It does not make sense to think about this month-to-month reverse causality for marketing as a whole for the industry, relative to sales as a whole for the industry. It's not how individual companies set their marketing budgets.
It just doesn't make economic sense to me, so for the analysis at hand, looking at the entire opioid industry, I do

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not believe that there's a conceptual basis for the same endogeneity concerns that we might have with an individual drug or an individual company.
Q. Your analysis compares your industrywide but-for scenario against a scenario with just the defendant manufacturers, correct?
MR. SOBOL: Objection.
A. So my analysis ultimately compares the predicted -- the actual predicted sales, so that's leaving everything the same with a world in which we pull out some subset of the marketing.
BY MR. ROTH:
Q. So what I'm trying to understand is I understand your position on the big but-for scenario with the whole industry, but why is endogeneity not a concern for the pulled-out set of manufacturers?
MR. SOBOL: Objection.
A. There's no estimation that's going on there, so endogeneity is a concern when we're estimating parameters using a

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regression model. It is not -- the second stage of my analysis is simply employing those parameters to predict a different scenario, and so endogeneity, it's -- it's not a relevant construct for that prediction piece.
BY MR. ROTH:
Q. If you look at Exhibit 14, this was the article you prepared for the Kaiser Family Foundation in 2003, and if you look at page 2, the last paragraph on the page, you say: In this paper, we examine the effects of two types of promotional spending for brands in five therapeutic classes of drugs, using monthly aggregate data from August 1996 through December 1999.
Do you see that?
A. I do.
Q. So you actually looked at five different classes of drugs. Do you recall what drugs they were?
A. Antidepressants, nasal sprays, nonsedating antihistamines, PPI's, which are proton pump inhibitors, and number 5, let me just look at -- there are some tables that

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are probably the easiest place. I'm blanking on the fifth one. Cholesterol, anticholesterol drugs.
Q. Turn to page 14, please.
A. Okay.
Q. And on page 14 you say: We take account of the possibility that spending on direct-to-consumer advertising and physician promotion and product sales are jointly determined by estimating instrumental variables, IV, models where all three variables are assumed to be endogenous.
Do you see that?
A. Yes.
Q. And I think you said yesterday this article only solved for endogeneity at the product level?
A. I believe so, yes.
Q. Okay. And if you look at the bottom of page 9, in the last paragraph it says: At the top level of the tree, which represents the therapeutic class of drugs, we estimate the impact of DTCA spending and detailing in the context of a Cobb-Douglas demand specification, double logarithmic. In

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the analysis of competition at the individual product level within each class we specify and estimate three alternative models: 1, an AIDS-type specification; 2, a logit model with log of quantity share divided by, one minus quantity share, on the left-hand side, and prices and promotional spending on the right-hand side; and 3, a Cobb-Douglas model in log levels.

Do you see that?

A. Yes, I do.

Q. And then on page 15, under Econometric Results, it says: We begin by presenting results in Table 3 for the top of the tree structure in Figure 2, the class level quantity equations.

Do you see that?

A. I do.

Q. And then if you look at Table 3, which is on page 25, the top two lines say: Class DTC and Class Detail, and they have an asterisk that says Endogenous, IV Estimated.

Do you see that?

A. Yes, I do. Actually, I can

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keep reading, but I think essentially the class level estimates are the sum of the individual product level estimates. So again, the instrumentation was at a product level.

Q. And then applied to the class level through aggregation?

A. That's right.

Q. Okay. And if you had disaggregated individual drugs or manufacturers in this case, you could have applied an instrumental variables method to each and aggregated them similarly here?

MR. SOBOL: This case, the opioids case, not this?

MR. ROTH: Correct, so let me reask it.

MR. SOBOL: Yeah.

BY MR. ROTH:

Q. If you had used disaggregated individual drugs or manufacturers in the opioids case we're talking about now, you could have applied an instrumental variables model to each individual drug and then aggregated them as you did in this article?

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A. Unlike the research question in this paper, my assignment asks me to compute the impact of the alleged misconduct at the level of the class, the industry, opioid industry as a whole. And so it was not appropriate for me to look at individual drug level analyses.

I maintain that at that class level, industry level, these endogeneity questions do not pertain.

Q. Did you test that hypothesis by looking at an individual defendant or two to see how the issues there compare to how your model handles endogeneity?

A. Since my assignment was an aggregate assignment, I have conducted my analysis at the aggregate level. I have not conducted my analysis at the level of an individual defendant.

Q. And, in fact, to confirm, you've not reviewed any individual defendant's marketing materials for any drug at issue in this case?

MR. SOBOL: Objection, asked and answered.

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A. I'm not sure what you mean by that exactly. I reviewed the documents that you see I relied on in my report. I would consider those to be marketing materials.

BY MR. ROTH:

Q. You've not reviewed any manufacturer's marketing plan for any drug at issue in this case?

MR. SOBOL: Objection.

A. Again, I'm not sure that that's entirely correct. I do cite to what I would consider to be marketing plans.

BY MR. ROTH:

Q. Okay. Aside from the documents reflected in Attachment B or cited in your report, you've not reviewed any marketing materials for any drugs at issue in this case?

A. Aside from materials cited in my report, I've certainly not relied on any of those marketing materials.

Q. And aside from the depositions reflected in Attachment B, you've not reviewed any depositions from any manufacturer's sales representatives?

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A. Aside from the depositions that I cite in my report, I'm not relying on any other deposition testimony, no.
Q. You've not reviewed any testimony or other direct evidence from doctors about how they were affected by a given manufacturer's promotion?
MR. SOBOL: Objection.
A. As I note in my report, as an economist, asked to examine the impact of the alleged marketing misconduct, interviewing physicians would not be a scientifically appropriate methodology to ascertain impact.
We know that self-report is unreliable, particularly when it comes to behavior that may be socially unacceptable.
BY MR. ROTH:
Q. So if doctors from Summit or Cuyahoga County testified at trial that they were detailed but it didn't affect them, as an economist, you would dismiss that testimony?
MR. SOBOL: Objection.
A. As an economist, I would rely on the evidence about what people do and not

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what people say. It's been demonstrated in the literature, literature that I cite in my report, that again, that self-report is not a reliable basis for ascertaining impact, so I would not rely on physician self-report.
BY MR. ROTH:
Q. If defendants presented testimony from 15 doctors at trial who all said their prescribing practices were unaffected by opioids promotion, would your position be different?
A. I do not believe that numeracy overcomes bias. There's no scientific basis for such a conclusion, so no, I do not believe that physician self-report is reliable, even if there are 15 physicians.
Q. So in your view as an economist, the testimony of any number of doctors regarding how they viewed the effect of defendants' promotion has no relevance?
A. I would not draw any conclusion from such testimony for the purposes that my report has been set forth.
Q. You did not review any manufacturer's disaggregated marketing data

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for the purpose of your analysis?
MR. SOBOL: Objection, form.
A. Again, in my report I cite certain documents that have data in them related to marketing. I do not use those data in my calculations.
BY MR. ROTH:
Q. And I think you said yesterday, you made a very specific request to look for such data. Do you remember that?
A. I did, yes.
Q. And why did you ask for that?
A. When I started my work, I wanted to know about what all the possible data sources that would be available were.
Q. And if you had a more robust source of disaggregated marketing data across defendants, would you have used that to model promotion instead of the IQVIA data that you used?
MR. SOBOL: Objection.
A. I can't say for sure, but I wanted to find all the data that I could from -- from discovery.
///

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BY MR. ROTH:
Q. You did not review any manufacturer's detailing call notes?
A. I did not review any detailing call notes, no.
Q. And I think you said this yesterday, but just to confirm, you did not comprehensively review all of any given manufacturer's marketing budgets for a specific drug in this case?
MR. SOBOL: Objection, asked and answered.
A. I did not systematically review those marketing budgets, no.
BY MR. ROTH:
Q. And so when you calculate the percentages in Table 3 of your report, as we discussed, that's just a comparison of removing each defendant's promotional contacts in the data from the aggregate model?
MR. SOBOL: Objection, asked and answered.
A. Table 3 presents alternative simulations of but-for scenarios in effect,

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grow is not conceptually inconsistent.
BY MR. ROTH:
Q. We agree that all detailing is not equally effective?
MR. SOBOL: Objection.
A. I -- here I am trying to estimate -- I am estimating the average effect of detailing. There may be some variation in that effect, but I'm interested in the aggregate impact.
And so the fact that my analysis averages across some -- some variation is not mathematically a problem. It will still lead me to the right answer in terms of the aggregate impact.
BY MR. ROTH:
Q. I assume you agree based on the way you've constructed Model B that the effectiveness of detailing changes over time?
A. That is what Model B captures.
Q. Right. Detailing that may have been effective earlier in time may become less effective over time as new information comes to light?
A. Well, I think the premise

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you're suggesting there is, again, it ignores the addictive nature of the product, so once a patient is using opioids and has increasing needs for higher doses; whether or not the specific messages are still in the mind of their physician, they are nonetheless addicted to the product or tolerant of the product and requiring higher and higher doses which will show up in my data as higher and higher MMEs.
So I can't quite agree with the premise and its relevance to the analysis.
Q. Based on your last answer, I assume you'd agree that when a patient receives higher doses of opioids, that may be a sign of tolerance as opposed to addiction?
A. Yes, higher doses may be tolerance and not necessarily addiction. Again, I'm not a clinical expert, so I want to be careful not to go too far with that.
Q. In fact, a patient who is being successfully treated with opioids for chronic pain may become tolerant and need a higher dose to achieve the same pain deterrent effect?

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A. I think we're getting a little too far out of my expertise and into clinical questions.
Q. Do you believe that promotion has a greater impact on the very first prescription a physician writes for a therapy like opioids or for subsequent prescriptions the physician may write for the same drug?
MR. SOBOL: Objection.
A. I'm not sure it makes conceptual sense to distinguish that. I think that there is a -- there is an inherent connection that happens when someone starts on a medicine. They have a higher probability of being on that medicine next month than someone who didn't start, right, so that -- that would be a natural underlying connection between the two things.
It may be that promotion also has a reminder effect, and so that would be an increment in addition to the fact of that patients once on a drug may be likely to stay on a drug.
I have not tried to distinguish those factors.

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BY MR. ROTH:
Q. Is that an issue that you have studied or seen economic literature on, whether promotion is more effective at getting doctors to initiate a therapy versus maintain a therapy they've already used in the past?
A. Again, for the purposes of my analysis, I had no need or wish to distinguish between those things. I can't point to a paper right now, but I believe that maybe someone has done that.
Q. I assume you're aware there are different classes of opioids, correct?
A. There are different molecules, like oxycodone and hydrocodone, is that what you're referring to when you say classes?
Q. Well, there are different molecules, that's one thing.
A. Yes.
Q. There are different formulations, right?
A. Yes.
Q. There are different methods of administration?

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A. Yes.
Q. There's a patch, right?
A. Yes.
Q. There's that sublingual spray?
A. Yes.
Q. And then there's pills and injectables, for example?
A. Yes.
MR. SOBOL: Film.
BY MR. ROTH:
Q. Film?
A. Yes, I'm aware that there are different formulations.
Q. And there's also immediate-release opioids and extended-release opioids, correct?
A. Yes, that's correct.
Q. And for the purpose of your models, apart from the injectables, all of those various forms of opioids are included?
A. Yes, that's correct.
Q. Did the manufacturers' marketing budgets that you reviewed show increased marketing spending over time?
A. As I sit here, I don't recall.

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Q. Would you agree that if the depreciation rate augments the stock of detailing over time, it would be irrational to keep spending money on promotion?
MR. SOBOL: Objection.
A. No, I don't think that that would be a conclusion that I would agree with.
BY MR. ROTH:
Q. And why not?
A. The more effective your marketing is, the more you want to spend on it.
MR. SOBOL: An answer I understood.
BY MR. ROTH:
Q. We spoke briefly about your errata yesterday. Can you just tell me how did that errata come about?
A. That came about from review partly, my very careful review as I was preparing for this deposition, and the staff doing the same.
Q. Got it.
And then why did it come in the

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form of a memo from Mr. McCluer to you and Mr. Sobol?
A. I'm not sure I can answer that question.
Q. But it sounds like the errors were identified some by you and some by the staff?
A. Yes, that's correct.
Q. Do you know who caught the Table 3 error?
A. That was me.
Q. I feel bad for the staff on that one. And what about the --
A. I'm not the yelling type.
Q. And what about the statistical significance error, was that you or the staff?
A. That was the staff.
Q. Let's turn to your indirect model.
A. Okay.
Q. So you talk about your indirect model beginning at paragraph 78 of your report.
And I guess just taking a step

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back before we get into specifics: Do you have a preference for your direct over your indirect model in this case?
A. I believe they have strengths. Each of them has strengths, so in my opinions, I have not favored one over the other.
Q. In general when you perform regression analysis, do you have any preference for a direct approach versus an indirect approach?
A. No preference. I think these kinds of models are really context specific.
Q. And if you look at page 53, paragraph 78, you start by saying: As noted earlier, the direct method of estimation is limited in part by the extent to which we can measure and include in the models all of the tactics allegedly employed by defendants, including manipulation of various professional societies and accrediting bodies.
Did I read that correctly?
A. Yes, you did.
Q. And that's based on the

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allegations that you reviewed?
A. That's correct.
Q. Would you agree that if a defendant did not engage in promotion other than the detailing measured by the IPS data, the direct model would be a more appropriate measure of that particular defendant's impact on the aggregate MMEs?
A. My assignment was to calculate aggregate impact, so I have not considered how to calculate impact for a single defendant.
As we talked about yesterday, I think there are some complicated questions about how to deal with the spillover effect, so I have not undertaken to do that.
Q. As we've discussed fairly exhaustively, your direct Model B explains over 99% of the variation in MME sales based on the detailing data in IQVIA.
A. Yes, it does.
Q. Does that not suggest that the effect of all of these other types of promotion is negligible at best?
A. It may well be the case that

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the amount of variation that is picked up by a broader measure of promotion would not be so much more. The indirect model is conceptually quite different, however.
Q. So if you compare Table 5, which is on page 61 -- let's take a step back, lay some foundation.
A. Sure.
Q. So Table 5 on page 61 is the output of your indirect model, correct?
A. It is.
Q. Okay. We talked yesterday about Table 2, which is the output of your direct model and appears on page --
A. Should I bend the corner so we can go back and forth?
Q. Yes, good idea.
So I want to compare the direct output in Table 5 on page 61 -- sorry, strike that.
I want to compare the indirect model output in Table 5 on page 61 with the direct model output in Table 2 on page 51.
A. Okay.
MR. SOBOL: Do we have a graph

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of this somewhere?
THE WITNESS: Not in my report.
MR. ROTH: Just for you. I don't think we've seen that. I would love to see it.
BY MR. ROTH:
Q. So looking at the two tables next to each other, I guess just first taking the bottom line, in Table 2, the direct Model B estimates that [redacted] of MMEs are attributable to defendants' detailing.
Do you see that?
A. Yes.
Q. And in Table 5, the indirect method suggests that [redacted] of MME shipments are attributable to defendants' detailing; is that right?
A. That's correct.
Q. So that's a [redacted] delta -- well, that's a bad question because that's not how math works.
MR. SOBOL: Right.
BY MR. ROTH:
Q. It's [redacted] higher -- well, the numbers are what they are, but it's [redacted]

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and [redacted] -- it's actually [redacted] higher, I think, if I'm doing the math right.
A. It is [redacted] percentage points or about [redacted] higher than the direct estimate.
Q. You said it better than I could.
How is that possible given that you had a 99% R-squared in the direct model that your indirect model could estimate twice as much impact by defendants' promotion?
A. As I mentioned, they are conceptually very different kinds of analyses, so whether or not detailing explains the vast majority of the variation in sales, it does not account for -- it accounts for a smaller percentage of total sales, so the magnitude of effect is not the same thing as the amount of variation explained, right?
And the indirect model takes the position that there are these long run factors that may -- that we can see are relevant to demand in -- across areas, and if we extend those forward, looking at the growth in MMEs only as a result of those

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factors, that's another version of what the world would have been like.

It assumes, again, that the drivers of the massive growth we saw were only related to defendant promotion, and so it allows defendant promotion to affect sales in a broader way than the direct model does.

Q. In the direct model, I believe you went through 2018; is that right?

A. Yes. There were differences in data availability, so yes.

Q. Right. So that was what I was going to ask you.

Direct goes through 2018, indirect only goes through 2016?

A. Yes. And as I'm sure we'll get to also, because the ARCOS data start in 1997, I do, I backcast for '95 and '96, but really I'm starting in 1997.

Q. Got it. So direct, you go '95 to 2018; indirect, you go from '97 to 2016.

A. That's correct.

Q. Okay. And that's just because of just data limitations?

A. That's correct.

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Q. If you had the other years, you would use them in the indirect model?

A. That's correct.

Q. If you look at paragraph 82 of your report, you describe your indirect model as a form of residual analysis.

Do you see that?

A. Yes.

Q. And can you explain what a residual analysis is?

A. Well, a residual is the leftover part, and so a residual analysis is an analysis that draws inferences not from something included, but something excluded.

Q. Sort of like in accounting, when you depreciate something, what's left after you've depreciated it is the residual?

A. Is it? Yeah, perhaps.

Q. Except if the depreciation somehow appreciates, but we won't go there again.

What is the baseline of your indirect model?

A. The baseline for the indirect model as I just mentioned is the 1997 level

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of MMEs.

Q. And you chose that because that was the earliest year available in ARCOS?

A. Yes, that's correct.

Q. How did you construct the explanatory variables you used in the indirect model?

A. The explanatory variables come from a variety of sources that I think we reviewed at a very high level yesterday. They're county level -- we haven't exactly talked about. So this is a county level cross-sectional analysis and we bring in data from a variety of government economic sources and other sources to capture county-level information.

Q. And we spoke about this a little yesterday with respect to Professor Cutler.

A. Yes.

Q. But the same question for you: Why did you decide to use national data and do a national model for direct regression, but then do your indirect regression analysis based on county-level data?

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MR. SOBOL: Objection, asked and answered.

A. Sure. The time series analysis that I did is appropriately done at the national level. We're trying to calculate national aggregate impact and the factors that drive sales over time make sense to do in -- at a national level there. We don't have promotional data at a county level, so it would not be possible to do a direct model at this level.

On the other hand, and this is why the indirect model complements the direct model, we can look cross-sectionally at variation in these socioeconomic and demographic variables because there's a fair amount of cross-sectional variation, and get reasonably precise estimates of the effect of those factors on MMEs.

And so the cross-sectional model works at the county level, and then rather than having to estimate the effects of those variables over time, we can trend them forward based on the cross-sectional analysis.

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BY MR. ROTH:
Q. That's right. So let's look at Exhibit 22, which is the data appendix that I believe you shared with Professors Cutler and Gruber?
A. That's right. As I mentioned, the ARCOS data for me come through Compass Lexecon.
Q. Okay. So we spoke yesterday about who helped you with your report, and it was Greylock McKinnon. Other than giving you the ARCOS data, did Compass Lexecon have any role in the preparation of your expert report?
A. No role in the preparation of my expert report, no.
Q. And did you speak with anyone from Compass Lexecon directly?
A. Yes, we talked about those meetings, and perhaps some of the calls, there were people from Compass Lexecon on those.
Q. But in terms of your regression analyses and running the Wald statistical tests, that was all Greylock and yourself;

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that was not Compass Lexecon?
A. Yes, that's correct, my staff ran these.
Q. Okay. So if we look at Exhibit 22, turn to page 11, and it's a section on the ARCOS prescription shipment data.
Do you see that?
A. Yes.
Q. Do you know who prepared this document?
A. I do not, no.
Q. It was not you or your staff as far as you know?
A. It was not me or my -- it certainly was not me. I do not believe it was my staff.
Q. So on the top of page 12, it says: The Drug Enforcement Agency, DEA, provides data on shipments of prescription opioids over time and across geographies. This appendix describes the source of these data and the steps taken to process and set up the data for analysis.
Do you see that?

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A. Yes.
Q. Then also on page 12, we'll get to this later, but it shows the DEA drug codes and names in the ARCOS data which are at the molecule level.
A. That's right.
Q. And that was why you couldn't separate out the Schedule IIIs, as we discussed?
A. That's correct.
Q. And then if you turn to page 13, the next page.
A. Yeah.
Q. Sorry, it's actually on page 14. That's my errata.
Do you see the section mapping shipments from three-digit ZIP codes to counties?
A. Yes, I do.
Q. It says: As noted above, the most detailed geographic area reported in the public ARCOS reports is the three-digit ZIP code. Three-digit ZIP codes are based on the first three digits of standard U.S. postal ZIP codes. These areas typically, but not

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exclusively, span across more than one county and thus are not directly comparable to the county level of data available for mortality, crime and geographic -- I'm sorry, crime and demographic and economic statistics.
Do you see that?
A. I do.
Q. And were you aware of that issue?
A. I was at one level. I had forgotten that there was a cross-walk from three-digit ZIPs, which themselves, again, are geographic areas that vary in terms of how big they are.
Q. Do you know how Cuyahoga County compares to the three-digit ZIPs that are reflected in the ARCOS data for that area?
A. I'm sorry, I do not.
Q. Do you know how Summit County compares to the three-digit ZIPs for that part of Ohio?
A. No, I did not.
Q. And if you look at page 15, it says: In order to link the ARCOS shipments data to the other county data, we have

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allocated shipments based on the weighted average population of census block centroids, center points that fall within each county that a three-digit ZIP code crosses. And then this means that when a three-digit ZIP code crosses county boundaries, we use the population at the census block level to estimate the share of population across counties for the three-digit ZIP.

Do you see that?

A. I do.

Q. An underlying assumption to this approach is that the shipments per capita within a three-digit ZIP code are the same across census blocks.

Do you see that?

A. Yes.

Q. And when it says "we have allocated," do you know who did that work?

A. Compass Lexecon, but I don't know who in particular.

Q. And did you do anything to test Compass Lexecon or whomever's underlying assumption that shipments per capita within a three-digit ZIP code are the same across

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census blocks?

A. I did not, no. I don't think it's possible to do that with these data because there aren't census block level data in ARCOS.

Q. And then they explain their methodology below with the mathematical formula of how they allocated ARCOS drug shipment totals to the counties based on population share?

A. That's right.

Q. And that's not an analysis you've seen before?

A. I'm sorry, what do you mean? I've seen this data appendix.

Q. Have you seen the analysis for how Compass Lexecon allocated ARCOS shipments to the counties?

A. I guess I don't know what you mean by "seen." I understand that they allocated based on population using this formula, so have I seen the individual calculations, is that what you're asking?

Q. Correct.

A. No, I have not.

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Q. Okay. And you would agree that just because a product is shipped to certain counties does not mean it's consumed there?

MR. SOBOL: Objection, asked and answered.

A. I think as explained in -- in the Cutler report, and Gruber may have said it also, to the extent that shipments are moving from one county to another, this regression methodology will -- it will just contribute to noise essentially in the regression.

So it's -- that -- the fact that there may be understatement of shipments in Ohio -- I think that's the premise here -- because there's overstatement somewhere else because they moved from one place to another, that itself won't bias this analysis. It may create some noise.

BY MR. ROTH:

Q. What is your basis for thinking there's an understatement of shipments to Ohio in the ARCOS data?

A. Well, again, it's really reading Cutler and Gruber's reports and the

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notion of the -- I guess it was the Oxy Express, so the shipments go to Florida, but they ultimately end up in Ohio and Kentucky and places like that.

Q. And have you done any analysis as to how the Oxy Express influenced consumption of prescription opioids in Ohio?

A. No, I have not.

Q. Do you agree that the census data on population is not necessarily connected to where opioids are consumed?

A. Allocating shipments based on population is a reasonable approach, and I think, you know, as they say in footnote 24, this is -- it's very common that we make such geographic cross-walks just because the way data are presented. It's a reasonable basis for allocating shipments in my opinion.

Q. I understand you think it's a reasonable basis. I'm not asking that.

I'm just asking the factual question. Where the population is shown in the census data is not necessarily correlated to where the shipments are consumed?

MR. SOBOL: Objection.

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A. Well, it almost --
MR. SOBOL: Asked and answered.
A. It almost certainly is correlated because you need peoples -- people to have consumption, but exactly what the relationship is, I can't say for sure. But again, it almost surely is a major factor in determining where the consumption is. It may not be perfectly correlated.
BY MR. ROTH:
Q. And people don't necessarily consume prescription opioids in their homes, right?
MR. SOBOL: Objection.
A. Well, I don't think that that's the -- that's the relevant question for my analysis. Again, I'm really looking at what factors predict shipments here, so wherever people consume them.
BY MR. ROTH:
Q. But you understand that your analysis is feeding into Professor Cutler's analysis and Professor McGuire's analysis who are trying to compute harms and damages occurring within Summit and Cuyahoga County?

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A. It's true, but the way my indirect analysis feeds into Professor Cutler's analysis is in the aggregate.
Q. If you turn to paragraph 84, that lists, I believe, all the variables you include in the indirect model; is that correct?
A. Yes.
Q. So you've got three categories, demographic, economic and healthcare variables.
A. That's right.
Q. Let's take those one at a time.
So the demographic variables you include are essentially gender, male versus female?
A. Yes.
Q. The percent in different age groups set out in your report as to how you divided them, it looks like into five different age -- six different age group -- five different age groups?
A. Sure. Sorry, these are just standard census categories.
Q. Okay. Another demographic

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factor you included is the percent of the population that is white, black and Hispanic --
A. Yes.
Q. -- so race.
And then the share of the population in four different education groups, correct?
A. Yes.
Q. And the percent of the county identified as urban, correct?
A. That's right.
Q. And are all of those census categories?
A. I believe so, yes. I think they all come from the ASEC that we talked about.
Q. Okay. And then in the second category, economic variables, you included the unemployment rate?
A. Yes.
Q. You included employment-to-population ratio?
A. Yes.
Q. You included the distribution

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of employment by major industry sector?
A. Yes.
Q. You included median household income?
A. Yes.
Q. You included the poverty rate?
A. Yes.
Q. And you included the county's population?
A. Yes.
Q. And then for healthcare, you only included two variables, correct?
MR. SOBOL: Objection.
You can answer.
A. Yes, I included two healthcare variables.
BY MR. ROTH:
Q. And one was the percentage of the population without insurance, correct?
A. That's correct.
Q. And the second variable is the number of cancer deaths, correct?
A. That's correct.
Q. Why did you include a variable to account for the percentage of the

Page 566

population without insurance?
A. I included that variable because I thought that there might be relatively widespread coverage differences across counties and that that might explain, as I think we talked a little bit about yesterday, the extent to which people go to the doctor and therefore get a prescription, and also, their likelihood of filling a prescription.
Q. Insurance coverage, though, is not a variable you included in your direct model?
A. That's correct. And I'm sure we'll continue to come back to this, but the cross-sectional variation, insurance coverage is a lot more substantial across counties than it is over time.
Q. In your -- what I'll call thought experiment, which we'll talk about in a minute, you include as potentially medically allowable prescriptions, surgery and trauma; is that right?
A. Yes. I guess we'll discuss the right words to describe that, but yes, so as

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the potentially appropriate uses, something like that I think is what I say, that surgical and trauma conditions, yes.
Q. But in your indirect model you don't have any variables for either surgery or trauma?
A. I do not, no.
Q. And why is that?
A. Well, the data from the healthcare utilization project that we will -- we'll talk about later, those cannot be disaggregated. There are some state-level data, but they're considered to not be reliable for that purpose, so those are national data only.
And ultimately, the trends in those -- sorry, wrong question, I was answering the direct model.
And ultimately, those factors, the numbers there, I don't believe that we have reliable estimates across counties over the entire time period.
Q. I'm a little confused because you just said the surgery and trauma figures --

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A. Yeah.
Q. -- cannot be disaggregated, but I thought in your last section you have a disaggregation of potentially appropriate MMEs for Summit and Cuyahoga that includes trauma and surgery.
A. Yeah, the HCUP data, those data are not at the county level. The other data are at the county level, the Area Health Resources File. So I was distinguishing between those two.
And in general, you can see, when we get to the appropriate uses, that the -- those trend downwards, and so even if we were to include those in the model and they had a cross-sectional relationship, it would not cause the indirect estimate to be increasing.
Q. But you didn't actually include those in the model?
A. I didn't, no.
Q. Did you consider any other variables to include in any of the three categories, demographic, economic or healthcare, in your indirect model, aside

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from the ones we've discussed?
A. No, these are the variables -- these variables are based on previous literature, all of those demographic and socioeconomic variables come from an assessment of what has been shown to be associated with opioid use.
Q. And what literature assessing the variables associated with opioid use are you relying on?
A. Well, I don't think I have a citation in here, so I don't know a specific paper as I sit here. Again, these are -- these are variables that economists studying opioid use have used from the census data.
This is the source of data that have been used by researchers. I think most of that literature is cited in Professor Cutler's report.
Q. Okay. And is -- was the list of variables you would use in your indirect model a subject of discussion between yourself and Professor Cutler?
A. I can answer that if counsel were present?

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MR. SOBOL: Well, yes or no.
A. Yes.
BY MR. ROTH:
Q. So if you look --
MR. SOBOL: You got so used to just running on that you forgot you could answer yes or no.
BY MR. ROTH:
Q. If you look at page 25 of Exhibit 22.
A. Okay. This is the data appendix?
Q. Yes.
A. Yeah. The Table 2?
Q. Yes.
So this is a table that reflects economic and demographic variables with data sources and years reported.
A. Uh-huh.
Q. And this is the shared appendix, but I assume these are the variables we've been discussing that you used in your indirect regression?
A. Yes, they are.
Q. Okay. So if you look at

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several of the rows, there's a shaded gray bar that says Interpolated.
Do you see that?
A. Yes, that's right.
Q. And what does that mean?
A. Well, some of the variables come only from the decennial census, so we have them for every ten years, so a linear interpolation was used between those ten-year points.
Q. And how do you know it was a linear interpolation?
A. Well, I should read more closely. I believe it is a linear interpretation, but my memory is not to be trusted.
Q. You know what, you're right. Actually, it says that at the bottom of the chart. Interpolated values are a linear interpolation between the preceding and following measured value.
A. Someone should do something about that font size.
Q. Who performed the linear interpolation on the census data for the

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variables that were interpolated?
A. I do not know the specific individual. These were constructed by Compass Lexecon.
Q. Did you consider picking a year where you did not need to do interpolation, such as the year 2000, as your baseline?
A. No, I did not consider that.
Q. Are you using interpolated values for these variables in your 1997 baseline?
A. Yes, I am.
Q. Is it possible the interpolated variables affect the baseline estimated relationship between the explanatory variables and shipments per capita per day?
MR. SOBOL: Objection to form.
A. These socioeconomic and demographic variables change very slowly, and I believe the linear interpolation method is entirely appropriate.
I do not believe that they are likely to cause any impact on my analysis, but if any, they would be a source of mismeasurement, which would dampen -- which

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would basically cause noise, but not bias.
BY MR. ROTH:
Q. Have you studied the linear interpolation that was done and how it might impact your analysis?
A. Well, I'm not exactly sure how one would study such a thing. Again, we undertake the interpolation because those data were not captured in those years, so there's not a gold standard to compare the linear interpolation to.
Q. But what you could do is pick a year where no interpolation were needed and compare the results from that year, say 2000, against '97 with the interpolation?
MR. SOBOL: Objection.
A. Well, as we discussed earlier, my effort was to undertake the cross-sectional analysis in a year that was unaffected by the alleged misconduct, and 1997, while imperfect, is a bit closer to that.
2000 would be a time period in which the alleged misconduct was well under way, so I did not consider such an analysis.

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A. Sure.
Q. And what papers would I read to describe how to conduct a proper simulation in economics?
MR. SOBOL: This one.
A. Simulations are used in a whole variety of settings. In general, the cost-effectiveness literature uses simulation as a primary methodology.
BY MR. ROTH:
Q. Okay. As you sit here now, can you think of a specific economics peer-reviewed paper that uses a simulation approach akin to the approach you take in Section X of your expert report?
A. As I sit here, I couldn't come up with a citation for you. My -- my recall for article names is not that good, but this is -- this is a pretty common approach, particularly when it comes to looking at the effects of policies, proposed policies.
Q. Have you published any research yourself that utilizes the same type of simulation approach that you outlined in Section X of your expert report?

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A. I have a recent paper that simulates a policy proposal that would, in effect, tax companies that raise their prescription drug prices above either the CPI or some other particular threshold, so that uses a simulation approach.
Q. And if we look at Attachment A, which is your CV, can you show me which paper you're talking about?
A. Yeah, let me just see. It was just published this year, but I think it should be on there. Sorry, that's my other documents.
It's article 119.
Q. Article 119. Generic prescription drug price increases, which products will be affected by proposed anti-gouging legislation?
A. That's correct.
Q. Beyond that article in -- 119 that you just identified, can you think of any other peer-reviewed publications you've authored that utilize the same type of approach you outline in Section X of your report?

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A. There is another one. Let me see if -- I just need to figure out what year it was.
Article 34.
Q. It's helpful that you number things, by the way.
So that's State and Federal approaches to health reform: What works for the working poor?
A. That's correct.
Q. Okay. Anything beyond those two?
A. I think that -- well, actually, I mention cost-effective analysis, and the article 115 is a cost-effectiveness analysis that uses a microsimulation model.
Q. Cost-effectiveness of Financial Incentives for Patients and Physicians to Manage Low-Density Lipoprotein Cholesterol Levels?
A. That's correct.
Q. Okay. So now we have three. Any others?
A. As far as I know, those are the relevant articles on my CV. Again, a

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simulation is commonly used as either a whole analysis or as part of an analysis. Sometimes researchers will take parameters that they estimate and then use them to simulate a policy change.
Q. And you've said a couple of times now, it's used to simulate a policy change.
Can you explain what you mean by that?
A. Well, in the case of the last article that we just talked about that we undertook a randomized control trial of financial incentives for doctors and patients to control cholesterol better, and we took what we learned in that randomized control trial and said what would happen basically if employers were to adopt this widely or if health insurance companies were to adopt this widely, what would happen to cholesterol control and downstream healthcare expenditures that would result.
Q. And to do that, you used a simulation similar to the one you used in Section X of your report?

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A. Yes, it's based on the same premise. We have some epidemiologic data and then some information about the relevant behaviors, and in this case, the treatment patterns for the patients.
Q. And you call this analysis a simulation study or is there some other term I should be using?
A. I call it a simulation, and as you can see, I then call it a thought experiment.
Q. Yeah. And it's simple simulation and a thought experiment, so I wasn't sure which is best. We may use both interchangeably, if that's okay.
A. Sure.
Q. What is the appropriate methodology in economics for conducting a simulation study such as the one that you have in paragraph 10 of your report?
A. Well, again, as I mentioned, a simulation generally involves some relevant population and then some behavioral parameters. And, I mean, the context will vary.

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In other contexts, we're looking at patients and their health behaviors. Simulations are frequently done around tax policy, so the relevant behaviors have to do with labor supply, for example.
And I do call this a simple simulation here because the only parameters I'm looking at are treatment patterns.
Q. If I wanted to find some peer-reviewed treatise or article that told me what the appropriate methodology is for a simple simulation such as the one you conduct in Section X of your report, where would I look?
A. I am not sure that there would be a single treatise. I think to the extent that there are methodological frameworks, I think they're likely context specific.
Q. So to figure out what the appropriate generally accepted economic methodology is for a simulation, I would have to review a bunch of articles that run simulations and determine the best approach myself?
A. I don't know if there's a

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single methodological paper that would apply here.
Q. Okay. So back to paragraph 91 --
A. Okay.
Q. -- you say at the end of the paragraph: In this section, I use epidemiological data and a simple simulation approach.
We talked about that.
And then the rest of the sentence says: To approximate the portion of the increased prescribing caused by the allegedly unlawful promotion -- I think you meant "that could possibly be associated."
A. Yes.
Q. Okay. So when you say promotion that could possibly be associated with using opioids, as we discussed, you're not a medical doctor, right?
A. That's correct.
Q. So you're relying on plaintiffs' medical experts to tell you what those parameters should be?
A. That's correct, in part, yes.

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Q. You did not make any independent assumptions about the type of patients that could have benefited medically from using opioids?
MR. SOBOL: Objection.
A. I -- as you can see and will note I talk about, I cite to a number of guidelines and articles, and I rely on plaintiffs' clinical experts to validate my assumptions.
BY MR. ROTH:
Q. Right, but since you're not a doctor, when you read the guidelines and articles, I take it you took direction from either a doctor or from counsel about what to take out of those articles?
MR. SOBOL: Objection.
A. Yes, that's correct.
BY MR. ROTH:
Q. Okay. And you don't have any medical expertise that you would need to make your own independent assumptions about the type of patients that could benefit from using opioids?
A. I am not a medical expert.

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Q. I want to look at paragraph 94. So towards the bottom of that paragraph, you say: Note that because I am not documenting the diagnoses and dosing associated with actual uses of opioids, I am not able to calculate how much of the increased use of opioids during the period in which the alleged misconduct occurred was in fact for clinically appropriate indications, dosages and durations.

Did I read that correctly?

A. You did.

Q. And that's similar to what we discussed yesterday. None of your analyses attempt to parse out whether the excess MMEs you identified were for medically appropriate uses?

A. Yes. Again, here I'm trying to calculate this maximum, just say let's just assume that, in fact, some portion of this growth is driven by better treating cancer patients, how much could that possibly be? But I have not been -- I do not have diagnosis codes that would allow me to precisely capture that in the data.

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Q. Do you know whether data with diagnosis codes for Cuyahoga and Summit County exists that you could use to do an actual analysis?

A. I don't know about whether data are available for Cuyahoga and Summit Counties specifically, no.

Q. And I read the sentence that I just took from paragraph 94 which you have emphasized a few times with italics as a limitation on your analysis, correct?

A. It's a kind of a limitation. It's just a really important clarification because I would not want someone reading my report to interpret the numbers that I've simulated to be actually representative of how prescriptions were -- you know, according to what diagnoses prescriptions were written.

So it's not really a limitation. The purpose of my analysis is to do something different, but it should not be interpreted as showing how much was actually used to address cancer pain.

Q. Your simulation is a hypothetical analysis based on assumptions you made from plaintiffs' experts' explanation of appropriate uses as opposed to a factual assessment of which prescriptions were medically necessary?

A. Yes. I mean, it is based on a set of facts, but it does not compute the share of prescriptions that were actually used for these indications.

Q. So let's look at kind of the foundational assumptions you've got in paragraph 92.

A. Okay.

Q. You say first: I conduct a thought experiment that allows me to calculate, in scare quotes, upper bound of how much of the growth in MMEs could be attributable to more intensive pain management for patient groups that according to plaintiffs' experts could have benefit from treatment of -- with opioids.

Do you see that?

A. Yes.

Q. And then you say: All of the underlying assumptions in this section have been developed in reference to the opinions of the plaintiffs' clinical experts, including Dr. Schumacher and Dr. Parran.

Do you see that?

A. Yes.

Q. Are there any plaintiffs' clinical experts who you rely on that are not Dr. Schumacher and Dr. Parran?

A. Not specifically that I rely on, no.

Q. Okay. I just was confused, because you say including, but you only named two of them, so I didn't know if there was someone else that's missing here.

A. I understand that there are other clinical experts. These are the clinical experts that I rely on.

Q. Did you review or rely on Dr. Ballantyne's report?

A. I did not, no.

Q. Are you aware that plaintiffs have withdrawn Dr. Parran's expert report?

A. I was not aware of that, no.

Q. Do you know which of the assumptions you made based on Dr. Parran's report in this section of yours?

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A. I don't believe any of the assumptions were solely based on Dr. Parran.
MR. ROTH: And so the record is clear for the reporter, we're actually talking about Parran, P-A-R-R-A-N, who is actually different than Perri, P-E-R-R-I. And Schumacher is S-C-H-U-M-A-C-H-E-R.
BY MR. ROTH:
Q. Okay. So based on the opinions of Dr. Schumacher and Dr. Parran, you next set forth the assumptions you make about what could possibly have been an appropriate medical use in paragraph 92?
MR. SOBOL: Objection.
A. Yes, I put forth those three categories of conditions that I understand have clear benefit from opioids.
BY MR. ROTH:
Q. Okay. So the first category is short-term treatment of severe acute pain, e.g., trauma or postsurgical pain, end-of-life pain/hospice care and cancer pain from active malignant disease.
A. That's right.

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Q. The second category you list based on Dr. Parran and Dr. Schumacher is actually sort of a noncategory, right?
A. Yes.
Q. Which --
A. Again, I'm sorry to interrupt you. Please finish.
Q. What you say in (ii) is: Chronic opioid therapy is not recommended for most common chronic pain conditions, defined as moderate to severe pain lasting beyond 60 to 90 days, including low back pain, centralized pain such as fibromyalgia and headache pain.
Do you see that?
A. I do.
Q. And we'll talk about this in a minute, but you actually exclude that from your thought experiment?
A. That's correct.
Q. And then the third category which is included is less common chronic pain conditions such as pain from advanced multiple sclerosis, sickle cell disease, pain following spinal cord injury and paraplegia

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or post-herpetic neuralgia, which comprise a small percentage of chronic pain patients and for which opioids may be considered a third-line therapy?
Do you see that?
A. I do.
Q. And actually, really, the only ones you include in your thought experiment are Romanette (i), which are trauma or postsurgical pain and cancer pain?
A. Yes, just -- I was going to just clarify. In this section in paragraph 92, I'm summarizing what I understand the opinions of the clinical experts have put forward in terms of appropriate uses broadly, and you're correct that when I go to implement my analysis, I'm focusing really on section (i), and I try to explain why.
Q. Okay. And we'll get there.
A. Yeah.
Q. So when you read plaintiffs' medical experts' reports, what you gleaned from those reports was that the only conditions they believed opioids are

Page 637

indicated properly to treat are those conditions listed in paragraph 92?
MR. SOBOL: Objection.
A. When I read those reports, I gleaned everything that I said in that -- in that extremely long sentence, which is a little more nuanced than I think what you just said.
BY MR. ROTH:
Q. Do you know whether plaintiffs' medical experts' positions regarding the proper indication of opioids today were the prevailing medical guidelines for use of opioids from 1995 to the present?
MR. SOBOL: Objection.
A. I am probably not the person to best characterize that, but I have looked at some of those guidelines, and I also have read the complaint, and I know that plaintiffs intend to prove that part of the misconduct influenced guidelines that were broader than these opinions.
So I believe by extension it must be true that there are guidelines from that period that suggest that it is safe to

Page 638

use opioids for things like chronic pain.
BY MR. ROTH:
Q. And you also understand that medical guidelines are not static, correct?
A. I understand that medical guidelines are not static.
Q. I mean, as a healthcare economist, I'm sure you've studied lots of drugs where indications and warnings and appropriate uses change over time?
A. Well, more specifically, I know in this case that there were updated guidelines issued.
Q. But in your thought experiment, you're imposing plaintiffs' experts' 2019 framework on opioid use from the entire period from 1995 to the present?
A. I think you mistake the purpose of my thought experiment. It is not to say what would happen if we imposed 2019 beliefs by these clinical experts, but rather to say in a world in which there was no misconduct, to what extent might the appropriate -- sort of appropriate efforts to address undertreated pain have led to similar

Page 639

patterns.
Q. So if I understand you then, your simulation is predicated on plaintiffs proving that the existing medical guidelines between 1995 and today were wrong as a result of defendants' misconduct?
A. Well, I think that you're giving a legal interpretation to my analysis that I'm not really in a good position to judge.
What -- the purpose of my analysis is to examine whether there might have been legitimate clinical drivers of the increase in opioids that could have explained a similar pattern of growth.
Again, as I understand it, defendants in related matters have said, you know, physicians began using opioids more heavily in the 1990s because of the recognition that pain was undertreated, so I'm simply examining that premise.
Q. But if your premise is to try to understand whether there were legitimate clinical drivers, why would you not use the clinical standards in existence at the time

Page 640

of prescription?
MR. SOBOL: Objection, asked and answered.
A. Those clinical standards are influenced by the misconduct.
BY MR. ROTH:
Q. So that goes back to my question.
An underlying assumption of Section X, your simulation analysis, is that plaintiffs can prove that defendants' misconduct influenced the extant clinical standards from 1995 until the present?
MR. SOBOL: Objection, asked and answered.
A. Again, I think that you're -- you're putting a sort of liability interpretation on this that -- that -- this is not a but-for analysis. You sound like you're describing it as a but-for analysis.
It's a thought experiment that says what if we use opioids to perfectly treat the patients that we know can be safely and effectively treated, what would that look like in comparison to the growth that we

Page 641

actually saw.
BY MR. ROTH:
Q. It's a thought experiment that says if the plaintiffs' experts are right about what opioids can be used for, then this shows how prescriptions compare to what they say opioids should be used for?
MR. SOBOL: Objection.
A. The thought experiment does depend on the assumptions about which groups could be appropriately treated. That is correct.
BY MR. ROTH:
Q. Put another way, your thought experiment does not measure opioid usage against the existing clinical standards in place at any point in time?
MR. SOBOL: Objection.
A. The thought experiment measures the level of opioid use that would have occurred -- sort of the highest level of opioid use that would have occurred according to what I believe plaintiffs' experts intend to prove is appropriate.
It is not based on any

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Professional organizations, states and federal agencies, e.g., the American Pain Society/American Academy of Pain Medicine, the Washington Agency Medical Directors Group and the U.S. Department of Veteran Affairs/Department of Defense have developed guidelines for opioid prescribing.

Do you see that?

A. I do.

Q. And why do you think the Department of Veteran Affairs and Department of Defense has their own guidelines for opioid prescribing?

MR. SOBOL: Objection, scope.

A. Because they provide medical care or reimburse medical care for active duty -- what is the general word -- military, active duty military as well as veterans.

BY MR. ROTH:

Q. And then it says: Existing guidelines share some common elements, including dosing thresholds, cautious titration and risk mitigation strategies such as using risk assessment tools, treatment agreements and urine drug testing. However,

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there is considerable variability in the specific recommendations, e.g., range of dosing thresholds of 90 morphine milligram equivalents a day to 200 morphine milligram equivalents a day, audience, e.g., primary care physicians versus specialists, use of evidence, e.g., systematic review, grading of evidence and recommendations and role of expert opinion, and rigor of methods for addressing conflict of interest.

Do you see that?

A. I do.

Q. And then it says: Most guidelines, especially those that are not based on evidence from scientific studies published in 2010 or later, also do not reflect the most recent scientific evidence about risks related to opioid dosage.

So not only is there regional variation, but actually in the medical community, there's variation in prescribing standards for opioids?

MR. SOBOL: Objection, scope.

BY MR. ROTH:

Q. Do you agree that's what the

Page 668

CDC is saying?

MR. SOBOL: Objection, scope.

A. I think what the CDC is saying is that both across professional organizations -- I think it's a little broader than the medical community, since we're talking about agencies, that guidelines vary.

BY MR. ROTH:

Q. And I assume, based on your testimony throughout the last two days and this sort of contagion effect that Dr. Perri coined, your view would be that those medical associations are influenced by the effect of manufacturers' promotion as well?

A. I believe that plaintiffs specifically point to those influences in the complaint, and so, of course, that is -- between that and Dr. Perri's report is where I get my information. I have not made an individual assessment of this.

Q. Again I ask, if promotion is this unifying thing that influences all physicians equally, why is there a variability in the guidelines that

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professional organizations come out with for the prescription and use of opioids?

MR. SOBOL: Objection, mischaracterizes prior testimony.

A. As I noted earlier, promotion will have effects that are different for different physicians, no doubt different professional organizations.

Because it has the same direction of effect doesn't mean they all start in the same place or end in the same place, and so guidelines vary across a number of seemingly well-accepted clinical areas.

BY MR. ROTH:

Q. And the effect that promotion has, if any, on those guidelines will also vary?

A. The effect of promotion on those guidelines may also vary.

Q. And neither your direct nor indirect regression models do anything to measure the effect of medical guidelines on the prescription and use of opioids?

MR. SOBOL: Objection, asked and answered, mischaracterizes prior

Page 670

testimony.
A. The direct model, Model C, includes events for guideline dissemination, and -- and the guidelines are not included in the indirect model.
BY MR. ROTH:
Q. In Model C you've got the five events -- I don't remember all of them from memory. I probably will soon. I think one was the joint consensus statement, which was a guideline; is that right?
A. Yes, that's correct.
Q. Were any of the others guidelines?
A. The JCAHO standards are similar to guidelines in they set expectations for hospitals.
Q. Okay. And beyond those two, I don't think the other three events were guideline related.
A. Federation of State Medical Boards, those, I believe, are focused really on liability issues.
Q. Did you consider using, for example, the CDC guidelines or other

Page 671

guidelines to test how your model would respond in Model C?
MR. SOBOL: Objection.
A. The CDC guidelines come out in 2016, which is at the tail end of my data, and as we talked about before, it was apparent to me when I included five events that simply adding more effects was not going to improve the performance of the model.
BY MR. ROTH:
Q. It wouldn't improve the performance of the model, but it might show that the performance of the model didn't stand up once you added multiple events?
MR. SOBOL: Objection, asked and answered.
A. Well, the fact that a model with more events did not look good doesn't mean the model that I chose with no events was unreliable.
BY MR. ROTH:
Q. If you look at page 17 of the CDC guidelines --
A. Incidentally by the way, I didn't try that model, so I don't know what

Page 672

it looks like.
Q. Good clarification.
So page 17 is the start of a long discussion of 12 bolded points that clinicians should consider when prescribing opioids for chronic pain.
Do you see that?
A. I see -- let's see.
Q. There are headings in between --
A. Yes.
Q. -- so it's hard to track, but --
A. I see 12, yes.
Q. Okay. And again, this is not consistent with the view that no patients should ever receive opioid for chronic pain; it just highlights thing clinicians should consider before prescribing opioids for chronic pain?
MR. SOBOL: Objection, scope.
A. I don't believe anywhere in my report I summarize a clinician's opinion that no patients should receive opioids for chronic pain.

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BY MR. ROTH:
Q. I don't want to go through all 12, but I do want to ask about a couple.
A. Okay.
Q. So if you look at page 21.
A. Sure.
Q. Number 4 in the section Opioid Selection, Dosage, Duration, Follow-Up and Discontinuation.
Do you see that?
A. I do.
Q. It says: When starting opioid therapy for chronic pain, clinicians should prescribe immediate-release opioids instead of extended-release/long-acting, ER/LA, opioids, recommendation category A, evidence type, 4.
Do you see that?
A. I do.
Q. So the CDC is making some distinction between immediate-release and extended-release long-acting opioids.
Do you agree with that?
A. Yes, this recommendation specifically applies to immediate-release

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opioids, yes.
Q. And your models don't distinguish between immediate-release or extended-release opioids or any other distinguishing characteristics of opioids other than calibrating them based on MMEs?
MR. SOBOL: Objection.
A. In order to accurately capture the impact of the alleged misconduct, I include all forms of opioids, including short- and long-acting.
My model is intended to capture any spillover effects, and to the extent that marketing of one product affects use of another, it appropriately captures those spillover effects.
To the extent that marketing does not have spillover effects, they won't be detected inappropriately.
BY MR. ROTH:
Q. Number 5 says -- it's on page 22 -- when opioids are started, clinicians should prescribe the lowest effective dosage. Clinicians should use caution when prescribing opioids of any

Page 675

dosage, should carefully reassess evidence of individual benefits and risks when considering increasing dosage to greater than or equal to 50 MME per day, and should avoid increasing dosage to greater than or equal to 90 MME per day, or carefully justify a decision to titrate dosage to greater than or equal to 90 MME per day.
Do you see that?
A. I do.
Q. So the CDC seems to be making a distinction in terms of potency with respect to the clinical guidelines.
MR. SOBOL: Objection.
A. Okay.
MR. SOBOL: Scope.
A. So they're talking about effective dosing.
BY MR. ROTH:
Q. And again, that's not something you control for in your regression models?
A. That doesn't make any sense as something to control for. Again, I appropriately used the number of MMEs as the dependent variable, so that is recognizing

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that the number of MMEs is what is clinically relevant when it comes to ultimately the harms that Professor Cutler looks at.
And so I do, in fact, capture MMEs in my model.
Q. Okay. So we had an extended conversation yesterday about the depreciation factor, and you said it was justified because opioids are addictive and patients need to titrate up.
Do you remember that?
A. Yes.
Q. How does that assumption hold in light of the CDC's clinical guidelines suggesting that physicians should maintain patients on lower doses?
MR. SOBOL: Objection, form.
You can answer.
A. Are you suggesting that because the 2016 guidelines warn physicians on not increasing doses that none of that happened during the period of my analysis, 1995 to 2018?
BY MR. ROTH:
Q. Well, I'm asking the questions,

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but I'm just suggesting that you didn't account for it in your analysis, including after 2016 when these guidelines were published.
MR. SOBOL: Objection.
You can answer.
A. I would respectfully disagree with that characterization. My analysis incorporates exactly that, and yesterday we had a brief conversation about a chart that shows the increasing MMEs per prescription that demonstrate that doctors were clearly not following this guideline.
This is precisely the concern with the opioid epidemic is that dosing has continued to ramp up, and, you know, whether or not this guideline has influenced physicians to date, there's certainly plenty of evidence that there were increased dosing patterns over time for patients who were on opioids.
MR. ROTH: Okay. Why don't we stop for a minute. I don't know if lunch is here, but this would not be a bad time to break since it's around

Page 702

Q. Okay. So in this analysis, you include all of the IDC-9 trauma codes except for the one specified on page D9?
A. That's correct.
Q. And apart from what you told me that the clinicians stated these would not be appropriate uses of opioids, you did not have any other basis for excluding them from your trauma numbers?
A. Well, I'm not a clinical expert, but I would say, on the face of it, the notion that opioids would be appropriate for adverse effects of medical care or drugs or poisoning is not something I would expect to be true, but I'm not a clinical expert, so I certainly use my judgment as a starting point.
Q. And certain opioids like Suboxone or naloxone might be, but are those taken out of this simulation as well?
A. They are not in my analysis.
Q. Okay. So back to paragraph 98.
A. Yeah, way back.
Q. So essentially, to measure the incidence of trauma, you use the data with

Page 703

the codes removed as specified in Attachment D?
A. That's correct.
Q. And you assume that a hundred percent of those patients are treated with opioids?
A. That's correct.
Q. And then you assume, according to paragraph 98, that each of these patients is treated with 30 MMEs of immediate-release opioids for three to seven days?
A. Correct.
Q. And for that statement, it looks like you are relying on a white paper from the American Academy of Emergency Medicine, and then the CDC guidelines that we reviewed earlier. Or is it just from the AAEM white paper?
A. I think they agree on these points.
Q. Okay. So let's look at the AAEM white paper, which I'll mark as Exhibit 26.
(Whereupon, Deposition Exhibit Rosenthal-26, AAEM White Paper on

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Acute Pain Management in the Emergency Department, was marked for identification.)
BY MR. ROTH:
Q. And this is the white paper you rely on as support for using 30 milligrams for three to seven days for trauma patients.
A. You've printed it very small, so --
Q. I did not, but someone did, and I apologize.
A. That's okay.
Q. Do we need a magnifying glass?
A. I'm not bothering your glasses. I'm going to hold it two feet in front of me.
Q. Well, then my next question is going to be particularly hard for you to answer.
MR. SOBOL: Is there a footnote on this?
BY MR. ROTH:
Q. I was going to ask where you see the 30 milligrams of an immediate-release opioid such as hydrocodone, because I didn't, but you may not be able to see even the text,

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so that might be a bigger problem.
A. Yeah, I'm -- I believe the guidelines -- some of the guidelines say start at the lowest possible dose. I'm not sure the 30 milligrams is in this guideline.
I believe that they all say use immediate release. Here, the second bullet under Upon Discharge From the ED: Emergency medicine clinicians should prescribe only immediate-release formulations at the lowest effective dose and for the shortest course, generally two to three days' supply.
I think the CDC guidelines say three to seven.
BY MR. ROTH:
Q. And is the 30 also in the CDC guidelines or is that somewhere else?
A. I don't think it actually is, and when I referred clinicians to this language, around the lowest effective dose, I believe that the 30 milligrams comes from getting a translation from clinical experts of what that lowest effective dose is.
Q. Okay. So that's clear now.
So now as I understand it, your

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assumption for 30 morphine milligram equivalents for trauma patients comes from Dr. Parran and Dr. Schumacher telling you that's what you should use?

MR. SOBOL: Objection.

A. There's some other guidelines that we'll get to around surgery that have some more specific doses, where I had those numbers to say, you know, should I use one of these. But they're not in this document. We'll get to them in the next section.

BY MR. ROTH:

Q. So for trauma, your dosage assumption comes from plaintiffs' experts?

A. It is -- yes. The -- the assumption, again, I did -- I used the guidelines to have that qualitative assumption, and I required assistance from clinical experts to make sure that I understood how to translate that.

But there were other guidelines that had some quantitative starting points, but not in these ones.

Q. And when you say clinical experts, that's Drs. Schumacher and Parran?

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A. That's correct.

Q. So for one patient receiving treatment for trauma in an emergency room setting, you assume 210 MMEs, which is 30 times the 7?

A. And which we do without a calculator, yes.

Q. That's true.

And so to calculate the total number of MMEs for all patients who visited an emergency room for trauma, you multiplied the patients in the data times 210?

A. The patients in the data times 210, yes.

Q. With the patients in the data being the page D9 description of which patients you looked at for trauma?

A. That's correct.

Q. Okay. So now let's talk about surgery, which is paragraph 99. So to identify patients treated with opioids related to surgery, you say the universe is patients who underwent surgery on either an inpatient or an outpatient basis.

A. That's correct.

Page 708

Q. And according to studies published around the time of the alleged misconduct, 41% -- sorry. Let me reread that.

According to studies published around the time the alleged misconduct began, 41% of postsurgical inpatients experienced moderate to severe pain.

Did I read that correctly?

A. Yes, you did.

Q. What do you mean by the time the alleged misconduct began?

A. Again, where I reference literature on undertreatment -- well, it's upset, so now I have to go back. I was looking for literature that predated the alleged misconduct, so that -- I just have to see where I first cite the Marks and Sachar paper in that footnote 117. So those are the studies that we talked about at the very beginning of this analysis.

Q. Is there any allegation that you're aware of that the alleged misconduct influenced the prescribing of opioids for surgical patients?

Page 709

MR. SOBOL: Objection.

A. I -- as I understand the misconduct, the misinformation would affect the treatment of patients being discharged from surgery like any other patients, yes.

BY MR. ROTH:

Q. So in your view, discharging patients from surgery with opioid prescriptions beyond those prescriptions that you classify as potentially acceptable would be something that plaintiffs are trying to recover for?

MR. SOBOL: Objection.

A. Well, it sounds like there's both a clinical and nonclinical opinion there, but again, remember this analysis is not decomposing actual use but trying to build up to a set of uses that according to clinical experts could have reasonably consumed opioid quantities over this period.

So again, we're not -- we're not sort of looking at what was done and parsing between appropriate and inappropriate. Just say, okay, well, there's going to be a set of people with surgery, and

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those people surely will have opioid use for some period of time. What would it look like if they all got treated.
BY MR. ROTH:
Q. So in paragraph 99, you again come up with 30 MMEs and seven days for surgery.
A. Yes, that's correct.
Q. So same as trauma?
A. Yes, the guidelines are quite similar.
Q. And for that conclusion that 30 MMEs each day is appropriate, you cite the MD Anderson Cancer Center Postoperative Pain Management Guidelines.
A. That's right. So that's the -- the document that I mentioned did have some quantitative benchmarks in it.
(Whereupon, Deposition Exhibit Rosenthal-27, MD Anderson Cancer Center Postoperative Pain Management Guidelines, was marked for identification.)
BY MR. ROTH:
Q. So let me mark as Exhibit 27

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the MD Anderson Cancer Center Postoperative Pain Management Guidelines.
And is this the document you were citing in your report?
A. It is.
Q. So it looks like this was approved, if you look at the bottom of the page, on October 30th, 2018.
A. Yes, that's correct.
Q. And are you aware that the algorithm used by MD Anderson to evaluate doses of pain management is what was used to come up with the dosage number? Strike that. That's not a good question. Let's just turn to page 3.
A. Okay. At some point, I would direct you to page 10, but we can go to page 3 first.
Q. Okay. We will get to page 10, I promise. It's in here.
A. Okay. Good.
Q. So it looks like they have sort of like a decision tree flow as to how they're going to come up with dosing for surgical patients, based on pain score.

Page 712

A. That's right.
Q. And it identifies different types of pain and the recommended treatment options.
A. Yes.
Q. So if you look at page 5, Appendix A describes the pain score, and it may or may not have highlighting on it.
A. It does. I appreciate the highlighting.
Q. Now you can see where we're going.
A. That's great.
Q. So if you look at page 5 in Appendix A, it says no pain is zero, mild is 1 to 3, moderate is 4 to 6 and severe is 7 to 10.
Do you see that?
A. I do.
Q. And then if you go back to page 3.
A. To page 3, okay.
Q. So for patients with a pain score of less than 3 who are not currently taking opioids, they recommend using

Page 713

nonopioids or weak opioids.
Do you see that?
A. Yes.
Q. And then for opioid treatment they refer to Appendix E, which is page 10, which we'll talk about in a minute.
A. Okay.
Q. Correct?
A. Yep.
Q. For patients with a pain score less than 3 who are currently taking opioids, MD Anderson recommends continuing the use of opioids and again refers to Appendix E.
A. Yes.
Q. For patients with a pain score greater to or equal than 4 and who are not taking opioids, MD Anderson recommends short-acting opioids.
Do you see that?
A. I do.
Q. And again refers to Appendix E, correct?
A. Yes.
Q. And then for patients with a pain score greater than or equal to 4 who are

Page 714

currently taking -- who are not currently taking opioids, MD Anderson recommends short-acting opioids -- we just did that one. Okay. Strike that. I'm getting tired.

For patients with a pain score greater than or equal to 4 who are currently taking opioids, MD Anderson recommends increasing the scheduled opioid dose.

A. Yes.

Q. All right. So now let's go to Appendix E on page 10. And we've conveniently highlighted this for you.

So if you look at hydrocodone --

A. Yes.

Q. -- it recommends 30 milligrams a day, right, 5 to 10 milligrams every six hours?

A. Yes. So 5 would be 20, right?

Q. Sorry, let me back up the truck. Okay. This is wrong.

A. Yes.

Q. So first we need to look at codeine, which is on the top of the page. So for codeine, it recommends 30 to

Page 715

60 milligrams.

Do you see that?

A. Yes. I did not consider codeine in the simulation per se, but go ahead.

Q. Okay. And now if we look at hydrocodone, it says for short-acting opioids, it's 5 to 10 milligrams every six hours.

A. Correct.

Q. Which if we do the math on that would be between 20 to 40 a day.

A. Yes. And 30 is right in the middle.

Q. Okay. And for long-acting opioids, 20 milligrams a day of Hysingla or 10 milligrams every ten hours.

A. I think in the flowchart we just looked at -- and again, according to clinical experts in this case, long-acting opioids are not recommended.

Q. Right. So it's 20 to 40 for immediate-release hydrocodone?

A. That's right, and 30 is in the middle of that.

Page 716

Q. It's the average.

A. It's the midpoint, it's the average. Yes.

Q. But then if you look at morphine, which is on the next page, that's also a short-acting opioid?

A. Yes.

Q. And it's 5 to 10 milligrams every four hours, which by math would get you 30 to 60.

A. Yes.

Q. So I guess what I'm trying to understand is how you get to 30 when one range is 20 to 40 and the other range is all -- is 30 to 60.

A. Sure. Again, that's why -- because the guidelines don't give one number, I referred this question to the clinical experts through counsel, and -- and was advised to focus on hydrocodone and was told that 30 milligrams was a reasonable baseline.

Again, assuming that there's some patients who will only get 20, some patients who will get more.

Q. So again, like with trauma for

Page 717

surgical pain, your decision to take 30 morphine milligram equivalents per day was driven by plaintiffs' experts' advice?

A. And it's grounded in these guidelines. And again, while the other guidelines that we looked at are qualitative in nature, as I understand the notion of starting with the lowest dose, that seems quite consistent with choosing 30.

Q. And so like with trauma, 30 times seven is 210, and then you multiply 210 for surgery with the number of surgical patients in the data?

A. That's correct.

Q. And then we should maybe just close the loop on this. So if we go back to the Attachment D.

A. Sure.

Q. Just to understand what data you're looking at for surgery.

A. Yeah.

Q. So it looks like page D10.

A. Oh, you're in -- it's page D14. I think we're on the same page. Aren't we?

Q. Page D10 talks about surgery.

Page 718

A. Oh.
Q. Page D14 is surgery in Cuyahoga and Summit.
A. I see. I was ahead of you. We'll get to that, I'm sure.
Q. Yes.
A. Yes. Yes. So Table D(b), which is also terrible labeling.
Q. Yes, so Table D(b) explains how you identified surgical procedures, and it says they're identified from the Area Health Resource File and the Health Resources & Services Administration data.
Do you see that?
A. Yes, that's correct.
Q. But then data was only available for 2005, 2010 and 2014?
A. That's correct.
Q. And so you had to linearly interpolate all the other values.
A. Yes, and as you can see, they barely change.
Q. But in any event, you only had data for three years, and so the rest of it was interpolated with the data that you had?

Page 719

A. I did interpolate.
Q. Okay. And so if you go back to the body of your report, Table 6, which is at page 70, essentially presents the math exercise we've been talking about, correct?
A. That's correct.
Q. It has kind of the cancer, trauma and surgical MMEs by year from 1995 to 2018 based on the inputs and assumptions we've been discussing.
A. Yes.
Q. And so according to Table 6, just looking at 1995, for example, there were [redacted] MMEs potentially clinically justifiable?
A. Yes.
Q. And then the next column is your sensitivity where you just multiply that number by 50%?
A. Correct.
Q. And so for 1995, your sensitivity shows [redacted] -- sorry, [redacted] -- start over.
For 1995, your sensitivity shows [redacted] MMEs were potentially

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clinically justifiable with the 50% increase?
A. Yes.
Q. And that's actually higher than the actual MMEs sold in that year?
A. That's correct. So that first number should be a negative.
Q. The first number should be a negative? I'm not sure I follow.
A. Well, of the total plus 50%, I guess the first -- the percentage there is of the -- of the unadjusted one, so it's correct, but --
Q. Yeah, it's correct. And what --
A. It actually would be negative if you did the plus 50%.
Q. Right. Okay. Thank you for that clarification.
A. It shows up in the chart more clearly.
Q. And actually, if we just look at '95 alone, even under your methodology, 75% of the actual MMEs sold -- or nearly 75%, would be potentially clinically justifiable?
A. Could have been accounted for

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justifiable use by -- by justifiable uses, right? So again, just to be clear that I'm not saying that 75% of actual uses were -- were delivered in that way, but they could have been.
The level of use was reasonably explained by this measure of need, if you would allow me to use that shorthand.
Q. And so if you use your potentially justifiable use methodology, including your 50% sensitivity analysis, it's not until 1997 that you start seeing more than a small departure from the actual MMEs sold?
A. Right. So in 1997, the actual is about [redacted] higher than the -- those justified by need.
Q. And then where is this actual MMEs sold number coming from? The IQVIA data it looks like? It says: Actual MMEs nationally from IQVIA, NPA, ARCOS, CDC.
(Clarification requested by the reporter.)
MR. ROTH: Okay. Sorry.
BY MR. ROTH:

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promotion of prescription opioids since 1995 was a substantial contributing factor to the increase in the use of prescription opioids in the bellwether communities.

Did I read that correctly?

A. You did.

Q. And that is based largely on the econometric models?

A. It's based on all the foregoing.

Q. Okay. And I noticed the way you worded that sentence was that the promotion was a substantial contributing factor; is that right?

A. That's right.

Q. Not that the unlawful promotion was a substantial contributing factor, because as we've discussed, you have no opinion on whether defendants' promotion was unlawful or not; you're relying on counsel's assumption.

MR. SOBOL: Objection, asked and answered.

A. Again, I -- perhaps I should have repeated the unlawful promotion, if

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proven. So as you say, I demonstrate that promotion caused sales, and I assume that plaintiffs will prove that all promotion was unlawful.

MR. SOBOL: By the defendants.

A. All promotion by the defendants was unlawful.

BY MR. ROTH:

Q. And because you assumed that all promotion by the defendants was unlawful, that assumption would include promotion even if a sales representative only dropped off peer-reviewed literature at a doctor's office?

MR. SOBOL: Objection, asked and answered.

A. My analysis includes all promotion by defendants. When I calculate the but-for scenario, I remove that regardless if some of that promotion used materials that were FDA approved.

BY MR. ROTH:

Q. Your analysis also includes promotion by defendants even if the sales representative had no interaction with the

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prescriber?

MR. SOBOL: Objection, asked and answered.

A. I think what you're suggesting is that detailing may involve an interaction with someone else in the office? Is that what you're referring to?

And, yes, as I understand the matter at hand, that the entire promotional enterprise is what is at issue here, and so I have appropriately captured all detailing in my econometric model.

BY MR. ROTH:

Q. Your analysis includes all promotion by defendants even if that promotion did not result in any change in the prescriber's behavior after they were detailed?

A. Well --

MR. SOBOL: Objection.

A. -- actually, I would respectfully disagree with that. My analysis only attributes impact where promotion resulted in an increase in sales.

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BY MR. ROTH:

Q. But you include in your analysis details that may have had no effect on the particular prescriber's behavior?

MR. SOBOL: Objection, asked and answered.

A. And if that is the case, then it reduces the incremental effectiveness of promotion that I observe, and therefore, the calculated impact. The possibility that some details did not produce change is incorporated into the estimates.

BY MR. ROTH:

Q. You include in your analysis detailing where the prescriber's rate of prescription may have actually decreased after the detail?

MR. SOBOL: Objection, asked and answered.

A. My analysis will incorporate the effects, negative or positive. Obviously on average they're positive. If there are some negative changes after a detail for some reason, those again will reduce the measure of impact.

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BY MR. ROTH:
Q. You include in your analysis detailing even if the prescriber never prescribed the medicine he or she was detailed on?
MR. SOBOL: Objection.
A. Yes. Again, just like the -- any detailing that has no effect or a lower effect, I guess that would be a version of no effect, if the individual detailed never prescribed. And again, that will reduce the impact of detailing in my model.
BY MR. ROTH:
Q. You include in your analysis detailing to prescribers who were already the lead authors of journal articles on the addiction risk of opioids at the time they were detailed?
MR. SOBOL: Objection.
A. If there is such detailing in my data, again, my estimates will appropriately reflect a reduced effectiveness of promotion for those details.
BY MR. ROTH:
Q. Your analysis includes

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detailing to oncologists prescribing for end-of-life cancer pain?
A. Again, to the extent that my analysis does not grow the size -- sorry, to the extent that promotion does not grow the size of the market by expanding the use of opioids, detailing, for example, to oncologists who may already have been prescribing opioids will not result in impact.
Q. Your analysis includes detailing to prescribers who are hospice specialists for end-of-life pain.
A. To the extent that there is detailing to hospice providers in my data and those uses would have occurred regardless of the promotion, my analysis will appropriately capture those effects.
Q. Your analysis includes detailing to prescribers who may be performing surgery or trauma intervention in the emergency room?
A. Again, to the extent that those -- my analysis will calculate the uses that occurred in this market as a result of

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the alleged misconduct. Regardless of how those opioid prescriptions were used in practice, as I understand, is appropriate to my assignment.
Q. Stated differently, your analysis includes any detailing in the data regardless of to whom it was -- let me start over.
Stated differently, your analysis -- can we just get a clean question and answer. Say something.
A. Yes. What was the question? I don't know what the question is.
Q. Stated differently, your analysis includes any detail in the data, regardless of who was detailed, what was said or what behavior changed or did not after the detail?
A. So my analysis is consistent with my assignment in that I examine and quantify the aggregate market expansion that occurred as a result of defendants' promotion during the period from 1995 to the end of my data in 2018. I do not disentangle the types of detailing; however, to the extent there

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are differential effects of detailing across groups, those will be incorporated into the estimates.
MR. ROTH: Our time may be done. Let's take a quick break. And I may have more questions or someone else may.
THE WITNESS: Okay.
THE VIDEOGRAPHER: The time is 1:35 p.m. We're now off the record.
(Recess taken, 1:35 p.m. to 1:51 p.m.)
THE VIDEOGRAPHER: The time is 1:51 p.m. We're back on the record.
BY MR. ROTH:
Q. Professor Rosenthal, in Table 2 you calculate the total percent of MMEs attributable to defendants' promotion to be [redacted] of MMEs; is that right?
A. That's right.
Q. To what do we owe the other [redacted] of MMEs?
A. The other [redacted] -- excuse me [redacted] percent of MMEs are owed to the promotion that is not excluded in the but-for scenario,

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so again, because I start my data as early as I can in '93, there's a stock of promotion that builds up, and then there's non-defendant promotion. So all those things are left in the model.

Q. So it's promotion prior to '95 by anyone and non-defendant promotion thereafter?

A. That's correct.

Q. And that explains [redacted] of the MMEs with the remainder being explained by defendants' promotion from 1995 to 2018?

A. That's generally correct. You know, there's a constant in the model, which I think we could go to Table 1 and in Model B, so there's a baseline level of [redacted] MMEs.

Q. Okay.

A. So that's in there as well.

Q. And then the same question for the indirect model, you calculate [redacted] of MMEs due to excess shipments, so is it fair to say based on your approach that the other [redacted] is due to the demographic and socioeconomic and other factors you model for?

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MR. SOBOL: Objection.

A. That would be due to the changes in all of those factors. Again, price actually has a negative effect, but the trend which is intended to proxy for non-defendant promotion and those other demographic, socioeconomic and healthcare variables.

BY MR. ROTH:

Q. Okay. And then if you look back at page 19 of your report, Figure 1.

A. Sorry, excuse me. I should just say again, in the indirect model as in the direct model there's also a baseline, right, so we're projecting growth from '95 forward. So there's a baseline level.

Q. Got it.

So if you look on Figure 1 on page 19, we haven't actually talked about this diagram yet.

A. Okay. Page 19. Yes.

Q. And is this a diagram you've used in other expert reports before?

A. I tailored this one specifically for this report, but I have used

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similar kinds of diagrams.

Q. And if we look at your diagram, you have the ecosystem of promotion in all of the lines between the various constituencies, and in the box in the middle, there's detailing, professional journals, samples, and meetings and events.

Do you see that?

A. Yes.

Q. And as we discussed, your model only accounts for detailing promotion, not for any of the other items in the box or any of the other boxes on Figure 1?

MR. SOBOL: Objection, mischaracterizes the testimony, asked and answered.

A. The direct model includes the measure of detailing only. The indirect model is intended to capture all of these kinds of marketing tools.

BY MR. ROTH:

Q. And then Table 3, which we've been round and around on, to the extent that you used Table 3 to assess the delta between a defendant's promotion percentage and the

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baseline percentage, that delta is capturing how that defendant's promotion relates to the aggregate average; is that right?

MR. SOBOL: Objection, asked and answered.

A. As we discussed earlier, I don't use the table in that way. I'm using it to narrow the aggregate by excluding individual defendants.

And when I do that, for example, to exclude Aventis, just as an alphabetically first choice, I am excluding ultimately the effect that I observe in the econometric model of Aventis' marketing, whether that generates sales for its product or someone else's product.

MR. ROTH: Okay. I think with that I am done for the time being. It's been a pleasure. I believe Mr. Metz has some questions, so I will be passing the microphone to him. And I can't promise I won't come back, depending on what else happens, but thank you so much.

THE WITNESS: Okay. Thank you.

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THE VIDEOGRAPHER: The time is 1:56 p.m. We're now off record.
(Recess taken, 1:56 p.m. to 1:58 p.m.)
THE VIDEOGRAPHER: The time is 1:58 p.m. We're back on the record.
EXAMINATION
BY MR. METZ:
Q. Good afternoon, Professor Rosenthal.
A. Good afternoon.
Q. My name is Carl Metz. I represent Cardinal Health, which is one of the distributor defendants in this case.
A. I apologize for forgetting the name of your employer as it were.
Q. That's all right. You're referring to testimony yesterday where you were asked about the distributor defendants, you named two companies, and the third name, Cardinal, eluded you. Yes?
A. Exactly, yes.
Q. Okay. At various places in your report, you refer to marketing defendants, correct?

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A. Yes, I do.
Q. And then in other places, and I'm sure this is not by design, you refer to the word "defendants" without differentiation.
MR. SOBOL: Objection to the form.
You can answer.
A. Yes, I believe I use that term. We could look to see how I use it.
BY MR. METZ:
Q. For example, in paragraph 64, which you're welcome to look at, and I'll quote this just partially. You say, quote: A causal relationship between the defendants', possessive, promotion and prescriptions of opioids.
Do you see that?
A. Yes.
Q. And do I understand based on your testimony over the last two days that despite using the singular term "defendants," we should not read that as referring to all defendants, correct?
MR. SOBOL: Objection.

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A. In this paragraph in particular, I'm talking about the defendants who have detailing that I'm measuring in my data, so those would be the marketing defendants.
BY MR. METZ:
Q. Okay. And by marketing defendants, you're not including any of the distributor defendants, correct?
A. I don't believe that they have marketing data in my data, so there may be places in my report where I refer to defendants where it's appropriate to talk about them more generally, for example, when I'm summarizing the complaint, but here I intend to describe the defendants who have detailing that is measured in the IQVIA data.
Q. Okay. So just to be clear, not -- as you believe it, not -- that does not include the distributor defendants, correct?
MR. SOBOL: Objection, asked and answered.
A. I believe that is true.
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BY MR. METZ:
Q. Okay. And it also does not include the pharmacy defendants, correct?
MR. SOBOL: Objection, asked and answered.
A. Yes, that is correct.
BY MR. METZ:
Q. So we take another example, paragraph 78, where you say, quote: An alternative method of identifying the impact of the defendants', possessive, misconduct, is to use an indirect method.
Do you see that?
A. Yes.
Q. And there again, you're using the term "defendants," but how we should understand that is the marketing defendants, correct?
A. Well, the -- in -- excuse me, the indirect approach -- it is getting to be late -- is, as you know, a residual approach, so it inherently is looking at all of these demographic, socioeconomic and healthcare factors that could have driven higher opioid use and attributes that which is left to the